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ELECTRIC STREET TRAMWAYS.

AT a meeting of the Incorporated Association of Municipal and County Engineers, recently held, Mr. Robert Hammond delivered a discursive paper on street tramways in general, and electric tramways in connection with municipal electricity supply works in particular.

The Buda-Pesth system of electric tramways was described as a model system for cities, and the overhead trolley system for suburban and country districts; but we doubt if the members of the Association are much the wiser for this paper. If they want to know what is an electric tramway, and to get an elementary knowlege of the different systems, there are plenty of cheap descriptive works on the subject. The paper does not put forward any arguments in favour of electric over other tramways, nor does it compare them; it merely gives some statistical matter regarding electric railways, and a very elementary dissertation on the division and distribution of electric currents, prepared specially for the instruction of the members of this association.

The storage battery system is shown to have hitherto failed, owing to the expenses connected with batteries being so large, and to the great weight they add to the car.

Under the heading "Best Method of Generating the Electrical Energy," we expected to find something of interest; but the paper does not refer in any place to either the "Best method," or any other method of generating electrical energy; what is really meant is the "best system of working from a central station," and the paper goes on to prove what has long been known that, if storage batteries could be used on a large scale at central stations, we could run tramways and electric lighting from one station. That *if* is, however, the difficulty, for the overlapping of the power and light loads introduces difficulties which at present baffle the efforts of engineers to cope with. Mr. Hammond thinks the matter has only to be "carefully thought out," if so he might just as well have carefully thought it out before reading his paper and embodied the result in his address. There is one little difficulty with accumulators which Mr. Hammond very likely considers too trifling to mention, and that is, no accumulator can charge and discharge at the same time. Of course, if he could invent an electric non-return valve to fix in between the dynamo and the accumulators, that little difficulty would also be overcome; but it has yet "to be thought out." In fact, the system brought before the Association by Mr. Hammond has only been thought OF; it has yet not only to be thought out, but *worked* out; and if some wealthy municipality or county authorities would find the money it might be tried, and it might work out if they had the right men to do the thinking.

There is not much profit in bringing up a scheme *in nubibus;* at that stage it is of no practical importance, and it is time enough to bring it before such societies when it has been thought out in every detail.

A brilliant idea, for which we give the author of the paper full credit for its originality, is broached in the concluding paragraphs of the paper. Briefly, his plan is to run the cars during the day from the electric light supply, and then when the electric light demand comes on in the evening, to disconnect the tramways and hitch on horses to the cars during the time of electric lighting above a certain load. By this plan the load curve at the power-house would be beautifully levelled up, becoming more like a Cape-of-Good-Hope than an Alpine peak. But what would the load curve on the horses be like? It would be nearly a dead level in summer, and a series of Alpine peaks in winter. Mr. Hammond has consulted a job-master on this horsey question, and that worthy man considers that the combination of horses and electricity would be a boon to job-masters, offering employment for horses in the evening after a light day's work. It would evidently be quite an exhilarating recreation for these horses to haul about electric cars with a ton or two of machinery on board and a crowd of delighted passengers.

We refer the author of the paper to a kindred proposal in another column, wherein a whole central station is put on board the car—a compressed store of gas, a gas engine, a dynamo, an accumulator, and an electromotor. This is a case where everything has been thought out, but we would back the horses to haul the same number of passengers cheaper than the whole combination would.

Some people actually believe there is a virtue in combining together many appliances. It seems just now to be a kind of mania. The Heilmann locomotive, the gas dynamo accumulator motor car, the central station electric horse car, and another scheme we have just heard of—a street car to carry a store of gas, a gas engine, compressed air pumps, a compressed air store, and compressed air engines to drive the car. In this proposal we have the same kind of aberration displayed; we have a prime mover in proximity to the axle to be driven, but instead of directly allowing the prime mover to run the axle, they put in a series of power transformers and gearing, all of which is worse than useless; it is entirely forgotten that electromotors are only gearing, like belts, spur-wheels, or cranks and connecting rods.

To return to the paper, we may say that the horse combination is not so whimsical as the others. It is not nonsensical; but it can never meet the case. The number of horses required for a short time would be very great, just as at present the number of engines and dynamos required for a short time is very great to meet the top of the load curve. And the hauling of idle machinery is a very grave objection, apart from the fact of its being idle. It costs money in interest while idle; and it would cost money to haul it during the idle time.

The cause of electric traction is not likely to make much progress by treatment such as it receives in this paper; the persons who heard it must have gone away scared, not only by the difficulties conjured up, but also at the proposals made to overcome them.

THE PRIMARY BATTERY AGAIN.

We notice in *La Lumière Electrique* of recent date, a description of the Barruet primary battery similar to that lately described by us under the name of the Fulgur battery. Like that, it is simply a modification of Daniell's. The invention, if there is any, in these improved Daniell's, must be a very limited one, as the improvement of the Daniell cell formed the subject of innumerable investigations, patents, &c., for years before the advent of the dynamo. The Reynier battery, which was introduced some years ago, was another of the kind; it figured for a short time before the public, but, like every other primary battery for electric lighting, it found a very limited application.

Barruet, like Fulgur, works the battery by continually charging accumulators, and runs the lights from the accumulators only. The accumulators are divided into sets, which are successively charged and discharged by an automatic switch, worked by a clock.

While approving of the ingenuity and skill displayed in these arrangements, we are by no means satisfied that the improvements are sufficient to carry primary battery and accumulator systems into much use. They may be adopted in a few isolated places, but we feel convinced that there never can be sufficient business in such electric light plants as these to support either a private firm or a company in their production; and even if there were a great demand for this kind of installation, there is no monopoly in the manufacture and use of a Daniell battery and automatic switch and set of accumulators. Patents for slight modifications on old inventions, especially when they are merely modifications in structure, are of little value, because such modifications are very numerously possible.

While it is an excellent thing to find a good workable primary battery for some temporary use, we do not think that any primary battery patents can ever be considered as fit and proper subjects for the investment of capital with a view to earning dividends. No patents of this kind can control the business, if such business exists. Patents are of value only in proportion to the extent of the monopoly they secure for their possessors; so that supposing a demand exists, or could be created, for primary battery and accumulator combinations, we should find every electrical firm in the kingdom with a complete set of their own design ready for the market.

Improvements in primary batteries, while of considerable scientific interest, are of little or no commercial value.

Brewery Analysis by the Aid of Electricity.

In certain brewing operations it is necessary to determine the amount of invert sugar present in a given liquid, and this is usually effected by means of a chemical process, in which a copper solution plays a prominent part. The copper absorbed by the sugar is then estimated and the sugar calculated from the result. As mistakes are not impossible in this process, and since accuracy is of great commercial moment affecting possibly the quality of huge quantities of beer, an attempt was recently made by Formanek to estimate the copper (hence the sugar) electrolytically. The process devised has now been modified by B. B. Ross, and is essentially as follows:—The copper in the form of cuprous oxide is precipitated in a beaker, then placed upon an asbestos filter, washed with hot water, and rinsed with weak nitric acid. The liquid is then made up to 200 cc. and platinum electrodes are introduced, connection being made with a battery giving a current equivalent to 0·5—0·7 cc. of electrolytic gas per minute. The anode employed is a flat spiral of platinum wire of Luckow's pattern and rests on the bottom of the beaker, whilst a vertically suspended platinum cylinder receives the deposit of copper. The increase of weight of this cylinder gives the amount of copper, and from this the brewing chemist calculates out the sugar. Test analyses show the remarkable accuracy of this method.

ELECTRIC PHOTOGRAPHY.*

In the May number of the *Cosmopolitan Magazine*, Prof. A. E. Dolbear makes the following suggestive remarks on the above subject :—

For a long time it was believed there were three different kinds of ether waves, known as heat, light, and actinic rays. The latter were supposed to be the ones that produced the chemical action on photographic plates, while light consisted of rays of a different kind, capable of affecting the eye. It was discovered, however, that the same rays that can produce vision can also heat a body, and also do photographic work, and what any ray can do depends upon the kind of matter it falls upon, so that all rays have similar characteristic properties. This discovery makes it plain that there is no peculiar kind of ether waves which can be called light, as distinguished from other kinds of ether waves. What is called light is a physiological phenomenon, and has no existence apart from eyes. So well assured is this, that the serious proposal is made to banish the word "light" from physics.

The sensitive coating upon a photographic plate is an unstable chemical compound, which may be broken up by mechanical pressure, by heat, or by ether waves. The proper wave length for a given plate depends upon the nature of its surface. The tanning of the skin, the darkening of newly-laid shingles, the colouring upon apples and other fruits, is a photographic process, as can be shown by shielding them from the sun's rays. It has long been known by photographers that pictures may be taken with ether waves much too long to be seen by the eye, if some other substances are used in place of the simple silver salts in common use.

Since it has been shown that ether waves of all lengths have an electro-magnetic origin, it has been apparent that all the effects of light can be duplicated with suitable electric apparatus. Lay a coin, like a half dollar, on a plate of glass, and let a few sparks from an electric machine fall on it. Remove the coin, and the glass surface will not appear to have been affected ; but if it be breathed on, the image of the coin will at once be seen, and that it is really engraved on the glass surface is evident, for it will not easily rub off. If a piece of photographic paper takes the place of the glass, it must have the imprint of the coin made upon it. It is not needful to have the sparks fall upon the coin, for, if it be enclosed in a dark box, brought near to an electric machine having short sparks passing between its knobs, the ether waves set up by the latter will be sufficiently short to affect the photographic surface, which may be developed afterward in the ordinary way. So it is actually possible to take a photograph of an object in absolute darkness, with the ether waves set up by working an electric machine. Not much has yet been done in this direction, but it is a new clue to chemical possibilities, and one may confidently look forward to the time when the qualities and colours of surfaces of many things will be changed to suit the taste by an application of electric waves of suitable length to bring about the proper chemical reactions, and an electric machine may become a necessary adjunct to the apparatus of the photographer.

STREET CAR PROPULSION.

An American inventor has out-Heilmanned Heilmann. While we have in the neighbourhood of London just seen the commencement of a line of street cars, each driven by a gas engine direct, and, we believe, with success ; this American system also employs a gas engine on the cars, but the gas engine drives a generator or dynamo, the dynamo charges a storage battery, and the storage battery drives an electric motor, and the electric motor drives the car. Could anything be more ridiculously absurd ? An electromotor is rather an expensive gearing, for it is nothing else in this case, and the storage battery is quite superfluous, as no storage battery can charge and discharge at the same time.

A car has actually been built with this amazing combination for driving it, and is said to run on a line in Chicago at half the operating expenses of the trolley system. If this statement is correct then the trolley system must be a great deal less efficient than even Prof. Kennedy made it out to be, for the efficiency of this combination cannot be over 20 per cent. at its highest value, and is probably less.

If this combination saves 50 per cent. over a trolley line, then we have no hesitation in declaring that by throwing out the storage battery and electromotor and driving by the gas engine directly through a variable speed gear, the expenses of operating would be halved again.

The car has, of course, also to carry a compressed store of gas.

We wonder when this nonsense is to end ? It would seem that the designers of these monstrosities take leave of their common sense when they enter upon electrical work.

In a recent patent we observed a similar proposal for the propulsion of steamships. In addition to the usual boilers and engines, the inventors propose to put in a dynamo to be driven by the engines, and the dynamo is to drive three motors, one on each screw shaft.

That so-called inventors can be found to believe in such schemes does not surprise us at all, but that they can get these hair-brained designs put into actual practice is astounding.

The trolley system is bad enough, but we think it much superior to anything like this compressed gas electro-storage electric motor system. The trolley, however, is capable of very considerable improvements, and its present inefficiency and objectionable features will, to a great extent, disappear in time ; the engineer has not done with it yet.

The fact that about 8,000 miles of street railways is worked successfully by the simple trolley, and only a few miles by any other electric system, proves it to be the best even in its present stage of development.

THE TREATMENT OF TRIGEMINAL NEURALGIA.*

By W. S. HEDLEY, M.D.Edin., M.R.C.S.Eng.

No one who has read Prof. Rose's paper in a recent number of *The Lancet*, descriptive of two operations for the relief of trigeminal neuralgia, can have failed to be struck by their brilliancy and success. It is one more instance of an increasing class of cases where surgery steps in to do what medicine has failed to accomplish. It may be freely conceded that in these two cases nothing short of surgical interference would have proved effectual ; the results, however, will be satisfactory in proportion to the assurance felt that the unsuccessful remedies had in the first instance been fully and fairly tried. Electricity is one of these. "The application of the constant current (from five to ten cells) to the face was recommended." To my mind these words point to what may be considered a crude and insufficient procedure, inasmuch as (1) by such a measurement no adequate idea is conveyed either to the operator or reader of the current-strength ("intensity") passed through the patient ; and (2) the application of even a known and measured quantity of electrical energy in this form by no means in such a case exhausts the resources of electro therapeutics. The former of these points is obvious to anyone possessing any electrical knowledge ; the second it is proposed to illustrate by the following case :

A man, aged fifty-three, had for about four years suffered from severe paroxysmal neuralgia of the second and third divisions of the fifth nerve. In September of last year he was, as he expressed himself, at the time, "desperate" from it. It was relieved by five milliampères of galvanic anode—the details of which application need not here be entered upon. On several subsequent occasions the same proceeding had been successful, and at other times the pain had disappeared under the administration of Indian hemp. After some months of complete freedom from pain he again (on April 5th) presented himself for electrical treatment. He said that for the past three weeks he had suffered "night and day." A variety of medicines, including Indian hemp,

* *Scientific American.*

* *The Lancet.*

had been used without benefit. He described the pain as "plunging like knives," "stabbing," "seizing the roots of the tongue," and he altogether bore an expression of great suffering. During a paroxysm the face became fixed in spasm, and he vigorously grasped the left side of the lower jaw, exercising powerful pressure with his thumb on the point of emergence of the mental branch of the inferior dental. Having examined the mouth without result for a probable "offending tooth," five milliampères of continuous current were locally applied for five minutes—viz., the anode (an electrode of 4 cm. diameter) over the seat of pain, and the cathode (14 by 8 cm.) at the nape of the neck. This was without effect. By the simple expedient, however, of insulating the patient and "taking sparks" over the points of greatest pain, it completely disappeared, and he went away smiling. A short-lived smile. Scarcely had he reached home when, within half-an-hour of the application, things were as bad as ever. Next day a similar application was followed by an hour's relief and a night's rest, but there was an immediate return of pain on getting out of bed next morning. Both as to symptoms and treatment this represents the history of the case for the next few days. On April 15th, besides the electrical application, a tooth (third left lower molar) was extracted at the patient's request, on the chance that there might be exostosis or other undiscoverable condition of the root. After half-an-hour the pain returned with much increased violence. On the 17th, the condition of the patient having in no way improved, and despairing of results from localised applications or drugs, the hydro-electric bath* was administered at a temperature of 98 degrees F. for 15 minutes—the current being obtained from an alternating light-circuit having a potential of 100 volts and 8,000 alternations a minute. Its strength was regulated simply by means of a sponge rheostat, with a 16 candle-power lamp in circuit. The effect was striking and immediate. From a condition of intense suffering on entering the bath, the patient found himself on emergence absolutely free from pain. Seven such baths were given on the same number of successive days—but from the first, with the exception of a slight "bruised" feeling for a few days, the freedom from pain has been lasting and complete. The patient says that he has felt from the first "a different man," and stoops down to lace his boots without misgiving—a position which before would inevitably have induced a paroxysm of pain.

Now, if instead of the above treatment this patient had been subjected to operation, the operation would with justice have claimed the result. As it is, this may be fairly credited to the electrical treatment. It is idle to talk of "cure" in such cases. The important questions are, how long will immunity from pain continue, and how far will the same procedure be successful on recurrence? It is more than possible that this patient may eventually have to be sent for operation, but, in the meantime, it is at least satisfactory to think that, before the more heroic remedy is resorted to, there are yet other weapons in the varied armoury of electro-therapeutics.

* Dipolar.

"A LIVING PRICE" IN ELECTRICAL ENGINEERING.

By SYDNEY F. WALKER.

While the whole world is resounding with the clamour raised by the working miner and his friends, in their efforts to secure what he considers to be "a living wage," it may not be amiss for electrical engineers to consider the, to them, equally important matter of securing a living price for their work.

Electrical engineering is considered, and with some reason, to be *the* profession of the future. It is the one profession not yet overcrowded, and it will probably be many years before there ceases to be room for those who know their work, and like it.

But on the commercial side of the question the outlook is not always so rosy, even in what are termed good times. In fact, it is almost an open question whether so-called bad times are not better for *bonâ fide* electrical engineering businesses, so far as profits are concerned, than good times.

So few firms have yet learnt the important lesson that all electrical engineering businesses are very expensive to conduct successfully; and so the majority of firms compete against each other in the endeavour to secure business that can only involve them in loss.

It ought surely to be an axiom by now, that in any business the only fund from which all expenses, all wages, all interest and all profits, are to be paid, is that formed by the profits on business done. In the case of electrical engineering, on installations completed, on sales made. And, if any business is to be successful, the rate of profit must be such, no matter how high it may seem, as will provide for all these items out of the annual turnover. Rents, taxes, gas, electric current, if used, stationery, stamps, telegrams, clerks, all have to be paid for. And you must advertise in some form or other if you are to secure business. It will be of no use dubbing yourself a manufacturer or contractor, and waiting for people to find it out. Not only must you let those you wish to be your clients know of your being established, but you must acquire their confidence. They must have a reasonable assurance that you are able to carry out your work, before they will place work with you. And when you have arrived at the stage when you may obtain work if your price is favourable, more expense awaits you, in the shape of tenders to be prepared, possibly drawings to be made, &c.

Even when you have secured the work and carried it out your expenses do not cease. In many cases the users are new to the apparatus, and little accidents occur, sometimes little mischiefs, which you will do wisely to make good at your own cost; the expense is less than the loss of business that would be involved if you did not. Even now your expenses are not at an end. Perhaps a friendly rival approaches your customer and makes disparaging remarks on your work. Perhaps he does not make any remark, he only shakes his head or shrugs his shoulders. In either case the operation will lead to further expense on your part to remove the impression your friend has created. And even after that your expenses are not at an end. You have to collect the amounts of your several sales or contracts—some times an expensive matter—and you have to keep an accurate record of all your transactions; of your sales, of your wages, of your purchases, what your contracts cost you, and so on. It will be said, no doubt, and with perfect truth, that all this is common to every engineering business. What the writer wishes to point out is, that while they are supposd to fall more lightly on an electrical engineering business, in practice they fall far more heavily. The very nearness of everything, the elements of uncertainty and of risk, all tend to increase the working expenses.

And the danger of this is so much greater because unseen. Engineers young to business, and those outside of the business entirely, are often unable to see why certain expenses should be incurred; and it is only sharp experience that teaches them, they meanwhile living in a fool's paradise, thinking how very well they are doing, while the older firms they are trying to displace are merely waiting till the inevitable awakening comes.

And so it may well turn out that in order to show an actual profit on the year's trading, your apparent profit may look very large indeed. Your young rival, for instance, who was, perhaps, lately on the staff of some other firm, calls it positively iniquitous; yet it represents to the electrical engineer in business, or to the shareholder in an electrical engineering company, a *living price* as truly, far more truly, than does the sum the working miner is claiming as a living wage. And if this is so, is not the cutting of prices that is so constantly going on, not only foolish but wrong?

Do not directors and managers of electrical engineering companies who sell below this living price, except under dire necessity, betray the trust reposed in them as truly as if they gave their companies' money away? And is not every private firm who do the same, similarly guilty to those who are dependent on them, inasmuch as it can only lead to financial disaster?

And yet look at what has been done in the past. To take an instance, when the Edison-Swan Company allowed a

discount on their lamps proportional to the sales, and so arranged that both large and small traders could secure a fair profit, what happened? *The consumer was actually offered these lamps at a lower price than the largest buyer could purchase them for.* And to-day there is the same foolish rush for the honour of supplying goods at less than cost, and yet out of this minus quantity must come all the expenses detailed above.

There are, of course, cases where firms tender for one thing and supply another, but the consideration of business of that kind hardly falls within the scope of this article. It meets its own reward, and usually at no distant date.

But if we look on the other side of the picture and ask who have been the successful firms, it will be found that the firms who have stood as electrical engineering has advanced have been few; but they have all been marked by the same characteristics.

Their work has been the best that the knowledge and experience at the time could produce, and they have usually followed their work, to ensure its success. This is often a source of very considerable expense.

They have kept steadily before them the fact that unless they secured, in the main, a living price, they could not go on advancing, they could not go on at all, and they have insisted on having their price.

They have been free from all the tricks so common to firms who wish to secure business at any price.

Their motto appears to have been "We cannot afford to lose, and we cannot afford to do bad work."

The writer does not wish to be misunderstood. There are times when it is perfectly legitimate to lower prices; there are times even when prices *must* be lowered, even to a very low margin over cost.

There may be times even when it is not only legitimate, but absolutely necessary to sell under cost. But these times should be rare, they should be the exception, and they should only be allowed under dire necessity.

In conclusion, the writer trusts that none of the readers of this article will imagine that he wishes in any way to put the dial of progress back. It would be impossible for him to do so. But he trusts also that none of them will imagine that mere cheapness will accelerate the progress of the advance of electricity, or that its advance will be retarded by the insistence upon the receipt of a living price for their work.

Whatever may be the commercial course in the future, whether marked by the unhealthy signs that have been so manifest in the past, or by the stronger, safer, and more manly status involved in a living price, the advance of electricity must, and will go on, like the advance of civilisation itself, crushing out of existence all that opposes its progress, and crushing first the weaklings who are afraid to stand by and guide it.

THE LIGHTING OF SEA FRONTS.

When we consider the advanced state of electric lighting in England it is surprising to find how little arc lamps are used for illuminating the promenades of sea-side places. It is perfectly true that Brighton, Blackpool, and one or more places have gloried in the electric light for a considerable period, but fashionable places, such as Folkestone, Southend, the Thames Embankment, and numerous other watering places, are totally unprovided with a system of arc lighting. True, the introduction of electric illumination into Folkestone will be a difficult matter, for the town authorities are completely opposed to innovations. Nothing strange or out of the common is permitted to enter its highly respectable precincts: street organs and nigger minstrels are rigidly excluded, and such a new fangled notion as lighting the sea front by electricity will not be appreciated. But it is not of Folkestone that we desire to speak, but of the inauguration of a complete system of lighting the promenade of Hastings. Last Saturday the chairman and directors of the Hastings and St. Leonards Electric Light Company invited a number of guests from various parts of the country to see what they had accomplished in the way of exterior lighting. Above all things the directors must be congratulated upon their choice of a season. They could not have hit upon a more appropriate time of the year. By having the ceremony at the end of June one saw Hastings at its best, and avoided the 'Arry and 'Arriett period, known as the close season for h's.

It is no small undertaking to light the whole of the sea front from the Hastings Fish Market to the end of St. Leonards. Arc lamps have existed for some years from the Fish Market to Warrior Square, but there was naturally a good deal of hesitation in extending beyond these limits. At last, however, the corporation were convinced of the surpassing advantages of arc lighting, and arrangements were made for a complete system. The old lamps were removed, the cables taken up, and an entirely different arrangement substituted. There are now 65 arc lamps, extending from one end of the promenade to the other. Viewed from the pier the effect is distinctly good, and clearly shows the advantage of the alternating arcs under certain conditions. The current is supplied at 2,000 volts by the ordinary type of Mordey alternators. The lamps are arranged across the 2,000-volt mains, a small transformer in the base of each lamp doing the necessary conversion. The lamps are of the Brush type, supplied by the Brush Company. The whole of the cables for the arc lighting have been supplied by Messrs. W. T. Glover & Co. The Hastings method of street lighting in connection with the ordinary distribution system has many advantages; it enables one kind of plant only to be used in the central station for all purposes; it has all the advantages of distribution connected with high tension, without the disadvantages of having to insulate the arc lamp and its accessories for high tension; the lamps may be turned on or off from the central station by using one return wire only; and, what is perhaps of the very greatest importance from the point of view of the central station engineer, is the fact that the use of street arc lighting in this way gives a certain fixed load during hours of the night when the private lighting is perhaps so small as to be not worth doing on its own account. The working expenses of a central station are greatly reduced by having a certain fixed load, such as that of the street lamps, during many of the hours which are usually unprofitable, and the ability during those hours to supply whatever private lighting there may be from the same mains and the same generators and engines as the street arc lighting, still further decreases the cost. Without disparaging other systems, it may be said that the arc lighting at Hastings has proved itself to be well suited to certain conditions.

To celebrate the event the electric lighting company gave a banquet in the evening at the Eversfield Hotel at which were present the Chairman, directors and officials of the company, the mayors of Hastings and Winchester, Mr. Raworth, Mr. H. Edmunds, Mr. Mordey, Mr. Geipel, Mr. Wallis-Jones, Mr. Hesketh, and many others. At the conclusion of the toast list the whole of the company went to the head of Hastings pier where the mayor of Hastings switched on the whole of the lamps. The visitors were afterwards driven along the promenade to witness the full effects of the lighting.

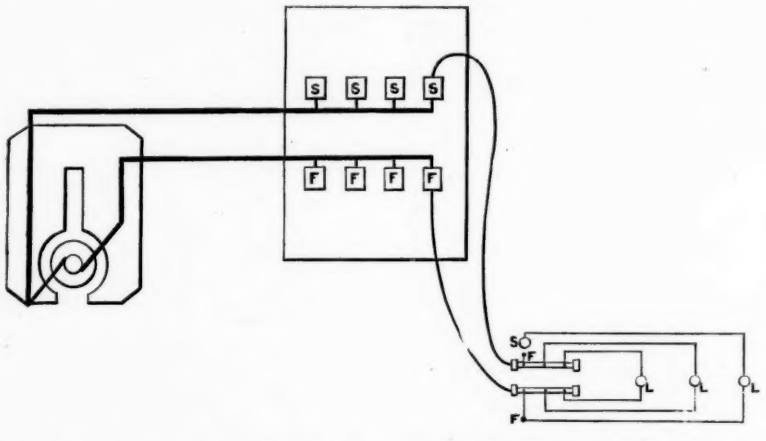
The Hastings Company deserve our heartiest congratulations for the highly successful manner in which the lighting has been done.

NEW SYSTEM OF SHIP WIRING.

It has been found that even in the best designed and most carefully carried out systems of ship wiring, the peculiar conditions prevailing at sea sooner or later affect the wires. Generally speaking, the ordinary methods of ship wiring have many inherent defects. We are not now speaking of jerry wiring, but good sound honest sort of work which has been done to last. It is the multiplicity of joints which constitutes the chief weakness of wiring systems. Jointing may be carried out in the most skilful manner, and the most careful jointers may be employed, but in spite of these the joints always remain the weak spots, and may at any time develop faults. This being then universally admitted, it goes without saying that any method which proposes to decrease

the number of joints ought to, and will, no doubt, receive careful consideration. We have lately had the opportunity of inspecting a method of ship wiring which is a distinct advance on existing systems. This plan, which may be almost termed a jointless one, has, we believe, been originated by Mr. Mackie, and used by him when fitting out the new Thames boat.

It is the experience gained by Mr. Mackie in fitting out other of the crack Thames boats that has led him to adopt, as far as possible, a practically jointless system on *La Marguerite*. The method is a simple one, and with the aid of the accompanying sketch our readers will have no difficulty in grasping its principle. From the dynamo a heavy main is taken to what we will call the main distributing board, the return being taken back under precisely the same conditions. The whole of the lighting is manipulated from this board. But the real point of novelty, however, is that the wires to every lamp are taken back to a small subsidiary board placed in various accessible parts of the ship; that is to say, a wire leaving the subsidiary board goes to one lamp only, and then returns to the board. The sketch shows two smaller mains taken from the principal board to a smaller one, the lamp wires being taken from a small omnibus bar provided with suitable sockets for making good mechanical connection. The subsidiary boards usually accommodate a group of six to eight lamps, so that in the case of a large saloon there may be two or more boards controlling the lamps. The switching on and off the lights is usually done from the boards. It is obvious, therefore, that with the exception of the connection of the wires to the lamps, the only joints are on the distributing boards. Should it be necessary at any time to increase the number of lights, "branch mains" could be taken from any of the subsidiary boards to other boards placed in suitable positions.



The first objection that naturally occurs to one is that, though Mr. Mackie's system may be a very desirable one from many points of view, the increased cost of mains would seem to make it almost prohibitive. We can, however, assure our readers that such is not the case. We have taken considerable trouble to go into the question of cost, and much to our surprise we find there is only an additional 10 per cent. to be added to the cost of wire for an ordinary installation. We want to be quite understood on this question; it is not an increase of 10 per cent. on the cost of an installation, but simply on the price of the wires. It goes without saying that if this additional cost is met, the system offers decided advantages. This extra cost of wires is compensated for in other directions. It is claimed, and we do not think the claim is too much, that there is a great saving in labour in making connections which more than meets the additional 10 per cent. on the wires. In the ordinary course of things, if we wanted to add one or two lamps, it would mean cutting away and connecting a branch main. By Mr. Mackie's method we should simply connect the two wires to the distributing bar in the box and carry them straight to the spot where the additional light was required.

The advantages of the system are, that you have localised, as far as possible, the points in your system which are most prone to go wrong. From the distributing box one can control the various lamps separately, and though this at first sight would seem to mean a multiplicity of switches, it is not really the case.

There is one point that we ought to mention in the installation on board *La Marguerite*. The dynamo and engine have been placed in a confined and inaccessible place in the engine room; it is so inaccessible, that it is absolutely impossible to get to the dynamo during any trip. We may add that the whole of the work, which we mentioned in our last issue has been done in a first rate manner, and is a credit to Mr. Mackie, and in keeping with the splendid appointments of *La Marguerite*.

CORRESPONDENCE.

The Mirror Galvanometer.

In your journal of yesterday's date I find the following statement:—

"It is generally supposed, and indeed we believe has been stated by Lord Kelvin, that it is a matter of indifference in what position the Mirror galvanometer is set up; that by means of the adjusting magnet the needle can always be brought to zero, and at the same time be made to have the same figure of merit in all cases. Some recent experiments by Mr. A. E. Perkins, the Gutta-Percha Company's electrician at the Wharf Road Works, seem to indicate that the supposition is not wholly true, and that there are positions in which, if the galvanometer is set up, the adjusting magnet cannot bring the needle to zero without reducing its sensitiveness."

That there is no foundation for the doubt here thrown on the statement which you attribute to me, you will see in a moment by imagining the magnetic force of the controlling magnet on the needle resolved into two components; one of them balancing the terrestrial magnetic force and the other giving whatever controlling force parallel to the planes of the coil is desired. These two components may be produced separately by means of two properly placed magnets, and in many cases it is really convenient in practice so to produce them. It is obvious, however, that the result can always be obtained by means of one magnet of sufficient power.

Kelvin.

June 30th, 1894.

A Complaint.

There is a marked difference between the first letter from Mr. George Kenyon, and the one appearing in your last issue.

We all know that commercial travellers *on commission* are famous for telling pretty fairy tales to enable them to obtain orders, more especially to persons they imagine know little about the business; but it is another matter when Mr. Kenyon asserts that first-class electrical firms appoint utterly incompetent men. For over 24 years I have been connected with

electrical firms, and I must say that Mr. Kenyon's letter came as a surprise; at the same time I am well aware that the *plums* are not, as a rule, given to the most experienced men, but rather to those young gentlemen who have the most influence, or have paid the largest *premiums*.

My chief objection is to *wiremen*, &c., on taking charge of a small electric plant, dubbing themselves *electricians*.

Electro.

Electrical Distribution by Alternating Currents.

In your leading article of to-day on alternate current distribution, you make what seem to me some very sound and pertinent strictures upon the utility of automatic methods of switching transformers in and out of circuit on a system of electrical supply. In common, no doubt, with many others, I have given considerable attention to the subject, and I came early to the conclusion—much the same as yours—that systems employing automatic or moving mechanisms at the transformers are out of the running from the point of view of sound engineering. From the very nature of the operation required there must be much and unavoidable complication in the apparatus; and it must be at the same time absolutely reliable in working under conditions not at all favourable to its effective maintenance or supervision. The requirements are too antagonistic to be both met successfully, and the use of the apparatus involves a compromise which may prove an evil of greater moment than that it is intended to mitigate.

Moreover, apart from this point, the question arises whether it were not better to employ the extra capital outlay required for such devices rather in securing a greater all-day efficiency in the transformers. It may well be that this is still a question of cost, though it is evident that there must be for every load factor a limit of all-day efficiency beyond which it is impossible to go higher. As far as I am aware, such limits have never been determined. I have been for some time, but in a desultory way, trying to locate these limits, but as yet with indifferent success. The investigation, when carried on as it should be with reference to the practical transformer as opposed to a merely theoretical or suppositious type, is extremely complex, and results are elusive. Presuming that the limit is not approached too closely already by the modern practice of transformer design, it is possible that the extra capital may be expended to more advantage in this direction. The point at least is still one to be considered in an impartial treatment of the subject.

However, the conclusion I came to was, that there was in any case room for a method of regulating the transformer capacity in use; but that it must not involve the use of any automatic appliances, or any apparatus entailing heavy maintenance and attendance charges; further, the extra capital expenditure incurred should be a good outlay in other respects and not an exclusive offering at the one shrine of transformer losses. That is to say, it should have other objects in view to share the expense, as it were, otherwise the extra capital charge might swamp the saving effected. I arrived at a certain proximity to this ideal in a system I patented last year.

From the tenor of your article, I judge that you have not yet made the acquaintance of my system, and I therefore beg to introduce it to you through the medium of the copy of my patent specification, No. 7,266, 1893, I forward you herewith.

You will note therefrom that in my system there is no switching mechanism at the transformers whatever, these being permanently connected to the mains. Also, that it adapts for its purpose the most economical system of low pressure distribution, and the fact that the maximum feeder voltage comes on the apparatus only during the short period of heavy load, enables the feeder voltage to be increased without a proportionate increase of danger or stress on the insulation. These advantageous features go to balance the increased capital, leaving what saving can be effected as a net gain.

In connection with this system, and, indeed, with every transformer sub-station system, should be used transformers with sectional coils and suitable hand switches, arranged so that the induction may be so varied for different periods of the year, that the full load capacity of the transformers for the induction used shall approximate more to the average maximum load of the season. By this means the annual transformer load factor should be considerably improved.

A word in conclusion as to large alternate current substations with attendants. These seem to me only feasible in very densely lighted districts: in the great majority of schemes, especially during the early stages, such large substations have no place at all.

J. Whitcher, A.I.E.E.

[The method described in the patent is equivalent to the system of running a third main or making two circuits, one of which can be completely cut off during the hours of light load. We fail to see any advantages in reversing one side of the three-wire mains; why not cut it off? Such plans are, to a certain extent in practice, but they do not reduce the magnetising current losses to anything like the extent to which they can be brought by attendants.—Eds. Elec. Rev.]

Variation of Electric Pressure.

In the paper just read by Mr. Chew before the Incorporated Gas Institute, I notice that there are given the results of a two nights' pressure test at the premises of an electric light consumer in Blackpool.

As these figures show a total variation in pressure of no less than 14½ per cent. on one night, and of 17 per cent. on the other, they may be cited by opponents of electric lighting to its disadvantage.

It may be as well, therefore, to point out that such abnormal results would not be found on any well designed system where the feeders and network were properly proportioned for their work, and where the station had some reliable means of knowing at any instant the pressure at the feeding points.

It is to be hoped that the electricity works laid down on the same lines at Madrid, Eastbourne, West Brompton, Dublin, Leeds, &c., do not show such results, and that there may be something out of the common at Blackpool (but not mentioned in the paper) to account for them.

M. S.

July 2nd, 1894.

Electric Lighting Specifications.

I should like to ask "Foreman," where is the comical element he refers to?

He says they are of little use to either officers or men. Now, I say that it is seldom a specification of work leaves the office door of the electric light contractor; as a rule, the foreman gets a schedule of lights alone; the loss in the mains, &c. (if he can work it out for himself), or more generally the current density in mains, then he has to fish for the rest.

Of the elementary principles of trade, &c., I have yet to come across them.

As to the clauses which will not be repeated by the much emphasised individual when he has gained that peculiar knowledge which time alone can impart.

I think this is the cream of the letter. Does "Foreman" profess to mean that all consulting engineers are amateurs? If so, I may at once tell him that he is mistaken. There are as good consulting engineers as there are foremen, and, if put to it, could instal and carry through a job with as good results, if not better, than "Foreman" would have us to think. "Foreman" seems to be one of those unfortunate individuals who have had the misfortune to work for one of the old-time firms, which were to be found in the early days of electric lighting, and who could not, or would not, advance with the times, officers and men being used to one system of work, and one system of ignorance, as, for instance, if a machine or an arc lamp was installed, and all went right, he got the credit for same; if not, well, to use his own words, he bluffed the buyer; it was the newness of the lamp or machine, and would work better in a few days. One occasionally meets with a firm of this kind, and the amount of bluff and ignorance to be heard is astonishing.

This kind of firm occasionally take contracts, never intending to carry out what they have contracted to do, but disregard the clauses in the most outrageous manner. I would remind "Foreman" that contractors are to blame for the birth of the consulting engineer. If people pay for

work, why cannot they have what they have paid for? What would be thought of a firm of builders if they erected a block of buildings different to the designs of the architect, and yet this sort of thing is done every day in the electric light business. If firms cannot get a price consistent with work done, to whom must be laid the blame. If "Foreman" does not know, let him scan the pages of the Electrical Review a little more closely. I am sure that the type is large enough for him to see, and also our worthy editor is pointed enough on the point at issue, and I do not see why the engineer should be blamed for what he is not responsible. He has his duty to do, and if he will not be bluffed out of it, all honour to him.

An Ex Foreman.

Tumbler Switches.

Allow us to point out that we think it in very bad taste on the part of the authors of your notice *re* Tumbler switches (we decline to believe it editorial) that it should appear whilst this question is *sub judice*, and, were the article not written so as to prejudice our position in the eyes of the trade, we should not have deemed it worthy of our regard.

When in 1891, after a great many experiments, we succeeded in overcoming the then supposed insurmountable defects of the Tumbler switches then in use, we submitted the first successful pattern to the Edison-Swan Company, offering them our improvements for sale, which they in the first instance refused. Afterwards they brought out a switch which they believed answered the same purposes, but its advent showed it to be an infringement, and ultimately the Edison-Swan Company acknowledged our patent rights and became licensees.

What more reasonable could we expect than that other infringing firms should also acknowledge our patent?

As regards the alleged delay, the truth is that no formal assignment of the patent having been taken, it became legally necessary to take such formal assignment to our company. This having been done and completed on Friday last, a writ was on that day issued, and eminent counsel retained.

We disclaim any desire to establish a monopoly (the nominal terms of our license proving this), but nevertheless feel that electrical firms who have spent many thousands of pounds and invaluable time in designing and creating the present improved fittings, should, after innumerable disappointments, have the satisfaction of a formal acknowledgment at least by firms of recent date.

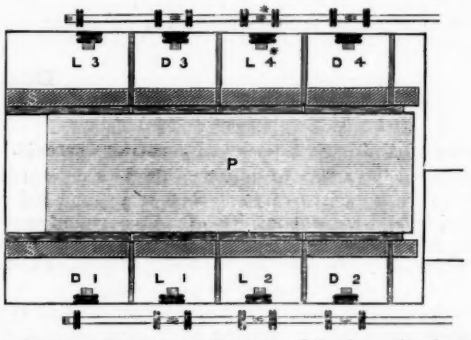
Too many of such electrical manufacturers forget, unwittingly or otherwise, that their risk and enterprise is confined to a more or less successful copy of fittings, the production of which, in the first instance, has not only for many years been an incessant strain and worry on the pockets and brains of electrical engineers, but has been the ruin of more than one electrical supply house.

The General Electric Company, Limited.

FATAL ACCIDENT AT BLACKFRIARS DISTRIBUTING STATION.

With great regret we have to record that another fatal accident occurred at the Blackfriars Distributing Station of the London Electric Supply Corporation on Saturday afternoon.

Before we pass on to speak of the unfortunate occurrence, we will give our readers a rough idea of the arrangements of the station, so that they may understand how the fatality happened. Practically, the distributing works are divided into two portions, the transforming room and the main room. A considerable distance divides these rooms, the transforming chamber being on the ground floor and the main room being underground. Into this latter room the trunk mains from Deptford enter and the London mains leave. There are four trunk mains from Deptford and four going out to London, making eight terminals altogether. It will be seen from the sketch which we have prepared that each main is numbered, the usual practice being to connect, say, D 1 on to L 1, the initials representing Deptford and London. In the event of cables on either side of the station becoming faulty, connections with other cables are easily made; for instance, if D 1 were faulty, D 2, or any other main, could be connected across to L 2. The end of each main, which we have endeavoured to show, terminates in a large plug or terminal, the connecting piece being a double fork insulated with ebonite. Of course it is understood that these mains are carrying a 10,000-volt current. The supply which is to be transformed at the Blackfriars Station is taken from



P, Insulated platform; D, L, Deptford and London mains shown in slate partitions; in front of partition are shown wooden guard rails. Omnibus bars shown outside. * * show the position in which Bungay fell.

Plan of Main Room at Blackfriars.

an omnibus bar placed about 2 feet above the plugs just mentioned. In the sketch this omnibus bar is shown on the extreme edge. We must here emphasise the fact that each main is brought into a separate slated partition about 2 feet in breadth, the slate being represented in the drawing by a sectional tint. Across each slate partition light wooden guard rails are placed, which would absolutely prevent a person falling on to the live mains. It might be mentioned here that a wooden platform on oil insulators is placed in the centre of the room, and all operations would be carried out from this platform. No earthed portion of the mains can be touched, as they are all carefully insulated.

The man in charge of the station was named Bungay, and we understand that he had the reputation of being one of the most capable, as well as the most careful men on the staff. Last Saturday afternoon he was on duty at the Blackfriars Station. It appears that the No. 4 London main had developed a fault; Bungay, with one of his assistants, tested the main to see which way the fault lay, whether on the Deptford or the London side, and found that it lay on the latter. It was decided, therefore, to connect No. 4 Deptford on to No. 2 London, a dead main, which on reference to the sketch will be found to be on the opposite side of the room. For this purpose the guard rail opposite L 4 was removed, as well as the one opposite L 2. This latter cable was tested to see that it was all right before a permanent connection was made. At this time the omnibus bar was connected to a live main, and was conveying a current at 10,000 volts to the Blackfriars distributing station. It was found that L 2 was all right, and Bungay's assistant left the room for some binding wire to be used in making the connection. The assistant states that he had gone about ten yards from the main room when he heard a slight explosion, followed by an exceedingly loud report. He returned with all haste to the main room, and found that Bungay had fallen backwards, his head resting on the bare plug of the live omnibus bar, the middle of his back striking the bare plug of L 4 main. A tremendous arc was struck, and the poor fellow must have died instantly, the condition of his body being too dreadful to relate. The two stars in the sketch show the position in which Bungay lay. The fuse went at Deptford, and it was at once surmised that something wrong had occurred. Assistance was telephoned for, but Bungay was past all human aid.

It is a most lamentable occurrence, and our sympathies are with the friends of the deceased, and the company, who lose a valued servant, and may receive the obloquy of unthinking persons.

It is perfectly clear in our opinion that no blame whatever attaches to the company. They have taken every conceivable precaution to guard against accidents; but the very protection which they had provided, namely, the guard rail, was left on one side in a moment of forgetfulness, and the awful and tragic penalty was paid. It is evident that Bungay, when falling, must have received a static shock from one of the mains, or that he was seized with sudden fainting. The guard rail in its proper position would have absolutely prevented him falling against the live mains. Mr. d'Alton and Mr. Partridge have given us every facility for enquiring into the sad affair.

LEGAL.

Woodhouse & Rawson United, Limited.

Public Inquiry before Mr. Registrar Hood.

(*Continued from page* 759.)

The enquiry into the failure of this company was resumed on Thursday, the 28th ult., before Mr. Registrar Hood, sitting at the London Bankruptcy Court.

At the commencement of the proceedings, Mr. C. J. Stewart, the Official Receiver, referred to the statement made on the former occasion by Mr. H. G. Rawson as to the papers and documents which were alleged to be missing. It was not the fact that all the documents referred to by Mr. Rawson had been produced, as several important valuations were not yet forthcoming. He (Mr. Stewart) was willing, however, to accept the assurance of the managing director that search was being made for these papers, and trusted that they would be forthcoming before the enquiry was concluded.

Mr. M. J. R. Dundas was then recalled, and, in reply to Mr. F. L. Rawson, said that, so far as he was aware, while he was secretary the business was conducted in a proper manner. The minute recording the retirement of the three directors, Sir John Coode, Sir A. Cappel, and Colonel Howard Vincent, correctly represented what took place at the board on that occasion, and, in general, Mr. Rawson was particular that the proceedings of the directors should be correctly recorded.

The **Right Hon. LORD ABERDARE, G.C.B., P.C.,** was next called and examined by the Official Receiver. He stated that he was one of the original directors of Woodhouse & Rawson United, Limited, and was considerably interested in the old company, having invested £4,000 in it as early as 1888. He had since increased his share holding, and at the date of the winding-up it amounted to £6,300, upon which there was a further liability of £700. He could not say that he was consulted by the directors of the old company, apart from his position as a shareholder, as to the amalgamation scheme; but Mr. F. L. Rawson, with whose family he was acquainted, called upon him and asked him to become a director of the new company. When he consented to act as a provisional director, he certainly understood that the business of the company was to be of a purely industrial character. When requested to become a director he at first declined, because he felt that owing to his age and his numerous duties, as well as the fact that he mostly resided in Wales, he should not be able to take an active part in the management of the concern. Upon the suggestion of Mr. F. L. Rawson, however, it was arranged that witness's son-in-law, who was a solicitor, and in whom he had the fullest confidence, should attend the meetings of the board on his behalf. On that condition he accepted the post, and attended one or two preliminary meetings of the directors. Before the company went to allotment, however, he was taken seriously ill, and was unable to attend to any business for some time. He was not present at any board meetings until February, 1890. From that date, until the following July, he frequently attended the meetings of the board, and was kept fully informed by his son-in-law and others of the proceedings that took place when he was not personally present. In July, however, he felt that he could not discharge his duties as a director to his satisfaction, and accordingly determined to retire. It was pointed out, however, that his retirement at that moment might be interpreted as indicating a want of confidence in the company and his colleagues, and he accordingly did not tender his resignation until the following October. He attended the meeting of shareholders held in that month, and explained fully the reasons for his retirement. He was cognisant of the statements made in the prospectus as to the profits of Woodhouse and Rawson, Limited, but was not aware at the time that the auditors had made a special report as to the nature of such profits. He complained that he had not been informed of this report at the time when the prospectus was issued, and the matter formed the subject of correspondence between him and Sir Rawson Rawson. He was informed that the matter had been carefully thrashed out by his colleagues, whom he considered to be perfectly competent and trustworthy persons. He (witness) was engaged at the time in an inquiry on behalf of the Government, and could not always attend the meetings. He must have been aware of the estimate (£75,000) made of the profits in the prospectus, and he had no doubt that this matter, like others connected with the company, was gone into with great minuteness and care. The item of £75,000 was partly made up of profit anticipated from the successful floating of the Elmore Copper Company. He understood that full inquiry was made into the value of the businesses acquired, and that competent valuers were employed for that purpose. He was aware that the patents taken over were valued at £159,000, whereas the price actually paid by the company was only £85,000. He always considered that the patent branch of the business was a most important one. He could not now charge his memory with the details of all that was done in the matter: but he was satisfied at the time of the honesty and completeness of the valuation. He certainly believed that the valuers were independent as well as competent persons, and the directors did all that reasonable men could do to ascertain the value of the various businesses and patents. He was not aware that the fee paid for the valuation was only £25, and if it was so he thought the amount rather inadequate, but it was impossible for him now to say what amount of work had to be done. He could not say whether some of the patent rights had expired before the formation of the company. He did not form any independent opinion as to the amount paid for goodwill, but relied in that matter upon the experience of Sir John Coode, Mr. F. L. Rawson, and Sir A. Cappel. When Sir A. Cappel, Sir John Coode, and Colonel Howard Vincent resigned, he considered that their retirement was a matter to be much regretted, and he saw them with a view to getting them to reconsider their decision. He understood from them that their retirement was due to the smallness of the public subscription, and not to dissatisfaction with the way in which the company had been formed or as to the soundness of its business. He was not present at the board when the interim dividend of 15 per cent. was declared in January, 1890. In February, 1890, it was brought to his knowledge that the report of the auditors of Woodhouse & Rawson, Limited, had not been issued to the shareholders, and he had a long correspondence with Sir Rawson Rawson upon the subject. The latter explained to him that the matter had been fully gone into at a meeting of the provisional directors at which witness was not present. To a certain extent he was satisfied with the explanation given, but he still thought that the report should have been brought to the notice of the shareholders. He remembered that objections were raised by the auditors to certain figures in the balance-sheets, and that there were differences of opinion between Mr. Pixley and Mr. F. L. Rawson on the subject, but he understood that the auditors were eventually satisfied as to the correctness of the accounts. He did not recollect the auditors warning the directors that it was unwise to declare a dividend until certain share profits had been realised. He understood that the whole question was one of policy, as the directors had been advised that they were justified in declaring a dividend upon those profits. In fact, as he understood the opinion of counsel, it was to the effect that the directors were bound to act as they did, and that they would not be justified in drawing upon the dividend guarantee fund while they had other sources from which to pay the dividend. He was aware that by the declaration of this dividend Mr. F. L. Rawson would be entitled to a commission of £13,000. No doubt Mr. Rawson, as manager of a large company, had his deficiencies, of which witness had been a severe critic, but he was bound to say that he had always found him to be an upright and honourable man, and he did not believe that Mr. Rawson would sacrifice the interests of the shareholders for the purpose of securing advantage to himself. He was aware that certain branches of the industrial business were not paying, but he did not know that on the whole it showed a loss. He was now of opinion that, as a matter of fact, the industrial part of the business was too much extended, having regard to the smallness of the capital, but he believed that with more money it could have been profitably worked. Some of the inventions owned by the company were no doubt of great value, and as a considerable amount of money and time had been spent in developing them, it was reasonable to anticipate that they would prove profitable. He did not remember any loss on the industrial branch of the business being referred to at the meeting of shareholders held in October, 1890, but it was certainly mentioned that the chief source of profit had been the promotion of undertakings formed to work patents belonging to the company. He (witness) was chiefly interested in the industrial branch of the business, and had always wished to see it extended. It was only gradually that he became aware that the company was becoming engaged in the promotion of other companies, but he understood that this was necessary for the development of its industrial business.

In reply to Mr. Pilling, the Witness said that he was not aware that the effect of the amalgamation scheme, according to the figures set out, was that the shareholders of the old company should receive back their capital three or four times over. All he could say was that the shareholders of the old company were consulted as to the amalgamation scheme, and that they agreed to it.

Mr. Pilling: If it is shown by the balance-sheet that you were to receive £14,000 for your share in the old company, would it surprise you?

Witness: It would indeed. No such vision ever crossed my mind.

In reply to further questions, the Witness said that, so far as he was concerned, he simply transferred his interest in the old company to the new one, and he had never trafficked in the shares of either company.

By Mr. H. G. Rawson: All the information which he required as to the position of the company was readily supplied to him by Sir R. Rawson, and he had no reason to doubt the fulness and accuracy of such information. He would certainly not have joined the company if he had known that a considerable portion of its business was to consist in the promotion of financial schemes. His chief reason for retiring was, that he felt he was getting out of his depth, financial business being entirely strange to him, and he would have resigned earlier than he did had he not feared that his doing so might be prejudicial to the interests of the shareholders. It was the fact that the accounts were always carefully examined before being passed by the board, more than one sitting being frequently devoted to a single item. He was convinced that neither he nor the other directors would have allowed a dividend to be paid unless they had been satisfied at the time that the profits represented by the dividend had been earned. So far as he knew, the only remuneration received by the managing director was 25 per cent. of the surplus profits shown after providing for a dividend and a reserve fund.

By the Registrar: The principal reason which induced him to join the board was, that he was interested in electric work, and had invested money in the old company, believing it to be the leading electric company in the country. Considerable pressure was brought to bear upon him to induce him to join, and it was possible that he had been too good-natured in yielding to it.

In answer to Mr. Muir Mackenzie, his counsel, the Witness said that he increased his holding in the company at various times during 1890, and he now held 787 ordinary and 351 preference shares. He had never sold, or otherwise dealt with, a single share in either of the companies.

Mr. Albert Hoster was next called, and, in answer to Mr. Stewart, said that he was a director of the old company, and was appointed one of the liquidators. He did not admit that the assets

vested in them were at all of an illusory character, although difficulties were experienced in the realisation of them. One reason of this was the prolonged litigation which took place between the company and the Edison & Swan United Electric Lighting Company. Among the assets vested in the liquidators was a share interest to the amount of £35,000 in the Universal Automatic Machine Company, Limited. It appeared from the minutes that the sum of 1s. in cash was accepted for this interest from Mr. F. L. Rawson, a note being appended to the effect that the shilling was expended in postage stamps, and used for the purposes of the liquidation. The liquidators acted under the advice of counsel in accepting this nominal sum, with a view to closing the liquidation.

Mr. Stewart: I do not suggest that you did not obtain the full value. I am sure you got the utmost farthing. The witness explained that the property of the automatic company had very much deteriorated through being left in disuse during a considerable period. The liquidators were advised that they had no power to compromise or settle their claim without the sanction of a general meeting of the company, and the expedient was adopted of accepting from Mr. Rawson a nominal sum, upon his undertaking to pay over any profits which might be derived from the machines.

The inquiry was then further adjourned to Thursday, July 5th.

On Thursday morning Messrs. Lambert and Philip Rawson, Sir Leopold McClintock, and others, were under examination.

The Edison-Bell Phonograph Corporation, Limited, *v.* The London Phonograph Company.

In the Chancery Division of the High Court of Justice, on Friday, June 29th, the trial of this action came before Mr. Justice North. On November 28th, 1889, a patent (No. 19,153, of 1889) was granted to G. G. Hardingham for an invention of "Improvements in phonographs," being a communication from T. A. Edison, of New Jersey, U.S.A. This patent was duly assigned to the Edison-Bell Phonograph Corporation, Limited, on January 21st, 1893. The validity of this patent was upheld in actions brought by the Edison-Bell Phonograph Corporation, Limited, against the Edison Phonograph Company and against Smith and Young. The Edison-Bell Phonograph Corporation, Limited, on February 14th, 1894, commenced the present action against the London Phonograph Company to restrain the infringement of their patent. The plaintiffs asked for an *ex parte* injunction to restrain the defendants from parting with the machines pending the hearing of the motion, but this was refused. Leave was obtained to serve notice of motion with the writ. The notice of motion asked that the defendants might be restrained until the trial of the action from supplying, selling, exhibiting or using any phonographs or phonographic machines or apparatus made according to, or in the manner described in the plaintiff's specification, or according to, or in any manner only colourably differing from the same, and from parting with any such phonographs or phonographic apparatus in their possession or under their control otherwise than to the plaintiffs. From the evidence for the plaintiffs, it appeared that the London Phonograph Company, which was the trading name of a Mr. Haugh, had been for several weeks continuously exhibiting to the public for gain, at 62, Old Broad Street, E.C., phonographs, and that these phonographs were infringements of the plaintiff's patent, and exhibited without license. The defendant, Haugh, had also been offering for sale parts of similar machines. The phonographs so exhibited, according to the plaintiffs' evidence, originally infringed practically all the claims of the plaintiffs' specification; in fact, had been made at the Edison works in America, under the American specification, corresponding to the English one in question in the action, but had been altered by removing the recording point from the diaphragm; they still infringed claims 3, 7 and 8. The recording point could be put on again. It was admitted by the defendant's evidence that his phonographs infringed claims 3 and 7 of the plaintiffs' specification, but it was alleged that these were matters which were old and well known. In the result, Mr. Justice North granted an interim injunction, and

The matter now came on for trial.

Mr. J. C. Graham appeared for the plaintiffs; the defendant appeared in person.

Mr. J. C. Graham, in opening the case, reminded the Court of the facts which have been summarised above, and said that the defendant denied infringement, but did not deny validity. He asked for the usual relief in a patent action. Having described the nature of the plaintiffs' invention, and the way in which it was worked, he said the claim was:—1. In a phonograph, attaching both the recording point and the reproducing point to the same diaphragm; means being provided whereby either of the points may be brought into operative position on the surface of the phonogram. 2. In a phonograph, the combination with the diaphragm of a pivoted lever connected therewith, and carrying the recording and reproducing points, and a pivoted weight or retarding device, acting upon the lever so as to regulate the action either of the recording point or of the reproducing point, whichever may be in use, substantially as herein described. 3. In a phonograph, the employment of a pivoted lever, mounted upon the arm carrying the diaphragm frame, and provided with a cam-shaped head which, acting on the guide rest, serves to lower or lift the said arm, substantially as herein described. 4. In a phonograph, the combination with a sliding spring-actuated cutting knife, of an adjustable stop pivoted to the knife stem, a chute carried by the said knife stem, a locking device operated by hand, and a withdrawing device operated either by hand or by engagement with a stationary part of the machine, substantially as and for the purposes herein described. 5. In a phonograph, the employment of a pivoted arm holding a single diaphragm to which both the recording and reproducing points are attached; the said arm carrying a knife for turning an old record off the phonogram, substantially as herein described. 6. In a phonograph, the combination with a fixed stop on the holding arm and a stop on the movable diaphragm frame of the mouth tube and the ear tube, having their inner ends differently formed, so that the mouth tube may engage with the stop when the movable stop is in one position, and the ear tube when the movable stop is in the other position, substantially as herein described. 7. In a phonograph, providing the swinging arm at the end of the phonogram cylinder with a spring lock arranged and operating substantially as described with reference to fig. 1 of the accompanying drawings. 9. In a phonograph feeding mechanism the employment of two nut segments, carried on separate arms, and adapted to engage independently with the feed-screw, substantially as herein described. 10. The improved recording and reproducing phonograph, arranged and operating substantially as described with reference to the accompanying drawings.

Evidence was then given in support of the plaintiffs' case.

Mr. Frank C. Cole, the superintendent engineer of the plaintiffs, said that on December 21st, 1893, he visited the defendant's shop at 62, Old Broad Street. On that occasion he noticed two phonographs. As far as he could see, these phonographs infringed the whole of the claims, with the exception of the sixth. Witness then gave evidence as to subsequent visits, and certain alterations which had been made by the defendants.

Mr. James W. Swinburne, electrical and mechanical engineer, gave evidence to the same effect. In his opinion the recording and reproducing points had originally been on the one diaphragm, and certain of the claims were infringed by the defendant.

Other evidence for the plaintiffs having been called,

Mr. Haugh, for the defence, contended that his machines had been so altered as not to come within the ambit of plaintiffs' patent. The plaintiffs' patent was for a phonograph with the recording and reproducing points in the same cylinder, and in his case the record was taken on one machine, and another machine was producing. He admitted infringement of certain of the claims in the plaintiffs' patent, but said that these were not patented *per se*, but only as a part of a combination, the essence of which he had not taken.

A number of witnesses were called for the defence.

Mr. Justice North, in giving judgment, said that he thought the defendant had admitted himself to be wrong upon two points, and therefore it was unnecessary to consider whether he was wrong on more points or not, because having admitted himself wrong as to two, the injunction must go. He need hardly say that he said nothing about the other action which had been alluded to, for it was immaterial at that juncture whether the plaintiff was entirely right or wrong as to that. The history of the matter was shortly this: Mr. Edison having taken out a patent for what was admitted to be a very clever improvement upon his original invention, apparently parted with the patent as far as this country was concerned, and it became vested in the plaintiffs. Mr. Edison apparently had continued to manufacture articles exactly according to this specification elsewhere, and some of them had been imported. That was the suggestion made by the defendant, and very possibly it was true. He could quite understand how the defendant might have thought that the purchase for sale or use of Edison's machines could not be an infringement of Edison's patent, but he was ignoring the existing state of things—that whatever rights Edison might have abroad, he had none here after he had parted with the patent, and the rights under the patent in this country were vested in the owners of that patent in this country. Then it seemed that the defendant did buy two of what probably were machines made by Edison abroad. As to one of them, he bought it without knowing that there were any questions pending, and as to the other, he bought it after he had heard certain questions were pending, and he procured the alteration before it became his property. He seemed to have made the alterations himself, but they were made apparently in November. His own case was that all these alterations were made not later than November, that was before there was any complaint on the part of the present plaintiffs of what he had done in this action. But then it turned out that he did not know all the truth. He had altered the machines in such a way as to make them harmless non-infringements, according to his view at the time, but it turned out that in other respects they were also infringements, and he in his ignorance, not knowing there was any harm in them, had not made the alterations in two points, and he admitted that after this action had been commenced, that he was using and exhibiting machines with such matters upon them. There was some dispute as to the time at which the alterations were made. It might be Mr. Haugh's view was right upon that; the Court was not deciding against him on the ground that it did not accept any of his statements. The fact was the defendant admitted that on two points the alterations were not made until after this action had been commenced, and after the matter had been before the Court. The suggestion was made that an inspection was given in March last, and one of these machines had been further altered, and that seemed to be perfectly correct; but Mr. Haugh's explanation that he had while the action was pending proceeded to alter one, leaving the other as it was, was clear and intelligible, and he did not think that he proceeded to alter one, cast any reflection upon his conduct in the matter. The only question was whether the things which the defendant admitted using were an infringement of the patent. That seemed to him to have been decided by Mr. Justice Wright in the action by the plaintiff company against Young. Reading Mr. Justice Wright's judgment, it seemed to him that these various claims were good and novel. There was *primâ facie* evidence of that in this case, and no evidence had been offered by the defendant to displace it. All that was necessary in this case, therefore, was to see whether there was formal evidence of what was proved before Mr. Justice Wright, and there was. That being so, all he could do was to say that illegal infringement with respect to the two points admitted was beyond all question, and therefore the plaintiffs were entitled to the injunction they asked for.

Mr. Graham: With costs?

Mr. Justice North: Yes.

Mr. Graham said the plaintiffs would take an account of profits.

Mr. Justice North asked if Mr. Graham disputed that the machine exhibited in Court was not an infringement?

Mr. Graham said he would rather not say anything about it.

Mr. Justice North: You do not ask that anything shall be given up or destroyed?

Mr. Graham: No.

Another Action against Mr. C. B. Harness.

In the Queen's Bench Division, London, on Tuesday, the case of Brasyer *v.* Harness and others came before Mr. Justice Charles and a special jury. In this case, Colonel Jeremiah Brasyer, a retired colonel of H.M. Army, sued Mr. C. B. Harness, Mr. J. Montgomery McCully, and the Medical Battery Company, for damages for negligence, misrepresentation, and fraud. The defendants, Harness and McCully, denied the plaintiff's allegations, and counterclaimed for damages for malicious prosecution.

Mr. J. G. Witt, Q.C., Mr. T. Terrell, and Mr. Gollan were counsel for the plaintiff; Mr. Jelf, Q.C., Mr. Horace Avory, and Mr. F. Dodd appeared for the defendant Harness; Mr. Abinger appeared for Dr. McCully.

In his claim the plaintiff stated that in June, 1892, he was suffering from pains in the back; the defendants falsely and fraudulently represented that they were highly skilled in the cure of the complaint of which the plaintiff was suffering, and that they were in a position, by means of certain pretended electrical appliances, to cure the plaintiff of his complaint. Relying on the faith of these representations, the plaintiff agreed to submit himself to the treatment of defendants, and to pay them £52 10s. as remuneration for the treatment. In July and August, 1892, the defendants, McCully and the Medical Battery Company, falsely and fraudulently represented to the plaintiff that he was ruptured, and that they could supply a truss which would reduce and relieve the rupture for £10 10s. The plaintiff purchased this appliance, and also paid McCully £10 for attendance and services. The plaintiff alleged that the defendants were utterly ignorant of his complaint, and that the appliances supplied were absolutely valueless except as devices for obtaining money. By reason of electric shocks administered to the plaintiff his health was seriously and permanently injured. In his action he claimed the return of the monies paid to defendants, and £1,000 damages.

The defence of Mr. Harness was a denial that the representations were false, or that the plaintiff paid him £52 10s. on the faith of the representations. The defendant further pleaded that on November 7th, 1893, the plaintiff falsely and maliciously caused him to be arrested and charged with conspiring to obtain money by false pretences. The defendant was remanded on these charges until January 31st, 1894, when the charges were dismissed by the magistrate, and the defendant was discharged. The defendant Harness counterclaimed £1,000 for his solicitors' bill of costs, £500 loss of salary from November 6th, 1893, to January 31st, 1894, and £5,000 damages for false imprisonment.

Mr. Witt stated that the plaintiff had been through the Sikh War and the Indian Mutiny, and was now 84 years old. Shortly after the commencement of this action the Medical Battery Company went into liquidation, and therefore as against that company the action was suspended. The defendants were now Mr. Cornelius Bennett Harness and Dr. McCully. Colonel Brasyer when a boy was run over and received injury to his loins, from which he had suffered ever since. Having read the Medical Battery Company's advertisements, he went in June, 1893, to Oxford Street, and asked for Mr. Harness. He saw some one who represented Mr. Harness, and was induced to sign a cheque for £52 10s. They said they would make a new man of him. He received an electric shock and an electric belt. The belt produced sores on his body. The electric shock administered by McCully was too severe and injured his shoulder. He had been also suffering from hernia, and he mentioned this to Dr. McCully, who sent him to a celebrated specialist. McCully sent in a bill for £47 15s, in addition to the 50 guineas. In respect of this bill the plaintiff had given a cheque for £10 10s., and on another occasion a £10 note. Thinking he had been cheated, Colonel Brasyer subsequently prosecuted Harness and McCully, but the magistrate dismissed the charge. In answer to the present action the defendants counterclaimed for damages for malicious prosecution.

The evidence of Colonel Brasyer, who was said to be at the Grand Hotel, Jersey, having been taken on commission, was then read to the jury.

Mr. Miller, registrar of the General Medical Council, gave evidence that Dr. McCully's name was on the Medical Register until November 22nd, 1887, when it was erased by order of the Council. Dr. McCully was struck off for having published a libel. He had applied to be reinstated, but had not produced his diplomas.

This was the case for the plaintiff.

Mr. Jelf immediately submitted that there was no case to go to the jury, as none of the charges against Mr. Harness had been made out.

Mr. Abinger also urged that as against Dr. McCully there was no evidence of fraud. The only money paid to him personally was £10, which was for attendances on the plaintiff at his hotel, and had nothing to do with the Medical Battery Company.

Mr. Justice Charles: The evidence is, that £10 was paid to him at Margate to get rid of him. His account was for £47.

Mr. Abinger contended that Dr. McCully was perfectly entitled to make this charge for his services and for taking the plaintiff to several specialists.

Mr. Justice Charles said it would not be right for him to stop the case either against Harness or against McCully. He thought there was some evidence against McCully, but with regard to Harness he had considerable doubt. In order to bring home a case of fraud against a man it must be proved either that he himself committed the fraud, or else that the fraud was committed by agents or servants acting under his instructions. Then Mr. Jelf said that in this case, if anybody was liable, it was the Medical Battery Company, and not Mr. Harness.

Mr. Jelf then addressed the jury. As a nation and as a people, the English loved fair play, and every man in this country ought to have the most perfect fair play before his character and his means of livelihood were taken away. Mr. Harness had not had fair play. Seldom was any man persecuted with such determination as Mr. Harness. All the blame must not be thrown on poor Col. Brasyer, who was merely a tool in the hands of designing persons. Doctors, and men in high positions, would tell the jury that these electrical appliances did people good, and cured them of complaints after other remedies had failed. Up to the time of this persecution Mr. Harness and the Battery Company had been in a prosperous condition, and had sold nearly 90,000 belts. The attacks were begun in 1887 by the Electrical Review. There had been several actions in which Mr. Harness had either been a party, or in which his interests had been affected. Several of these actions had been settled, and one or two had ended disastrously for Mr. Harness. Mr. Harness was not a wealthy man, and several of the actions had to be dropped on the ground of finance. Attacks had been made by certain newspapers who could spend thousands and thousands of pounds in carrying out their designs. The avowed object of the enemies of the Medical Battery Company was to destroy the company; they had succeeded in driving it into liquidation, but the liquidator appointed by the Court was still carrying on the business and selling the belts. If the belts were a fraud, the Court would not allow the liquidator to continue the sale. Mr. Harness had suffered greatly from this persecution, but the day of reckoning was at hand. The learned counsel asked the jury to pay that reckoning by awarding Mr. Harness handsome damages.

Mr. Abinger maintained that Dr. McCully had also been maliciously prosecuted. Dr. McCully was M.D. of Dublin University, and became, many years ago, a member of the Royal College of Surgeons. He had received a commission as surgeon in Her Majesty's army, and served in India. He resigned his commission on account of ill health, and was appointed officer of health of a large district at a salary of £800 a year. He gave up this to establish a private practice at Manchester. In a passion he wrote a libellous letter, for which he was imprisoned. The imprisonment affected his practice, and it was owing to these circumstances that he entered the service of the Medical Battery Company at a salary of £350 a year. In this employment he had done nothing to justify the charge brought against him by Col. Brasyer.

Mr. C. B. Harness, in evidence, gave particulars of his early career, and the part he took in forming the Medical Battery Company. The first attack upon the belts was made by the Electrical Review. It was said that the belts did not generate sufficient electricity, and therefore, in 1883, he brought out a patent for connecting the belts with an electric battery. The paper continued to criticise the belts by saying that the resistance of the skin was so high, that no current of electricity could pass through it. In 1884 another patent was taken out for improving the belts. It was in July, 1883, that he first engaged a medical man as part of the staff, and Dr. Stephens continued on the staff for some time to advise people as to whether the belts were suitable for them. The Medical Battery Company was formed in 1884, with the same shareholders as the previous company, but with enlarged powers. The total expense of fitting up the premises in Oxford Street with appliances, &c., was £25,000. The advertisements in the daily papers clearly stated witness's position, and he was never represented as a medical man. In 1889 witness had a slight paralytic seizure, and was treated at the institute in Oxford Street in the same way as other people had been since treated. He recovered. His wife, in 1890, also broke a small blood vessel on the brain, and had paralysis, being subsequently treated at the institute. She recovered, although an eminent doctor had given up her case as hopeless. Witness got Dr. Vigouroux over from Paris for the institution, and to report on the belts. He also got many doctors and electricians to report upon the belts. These gentlemen were absolutely independent of the Medical Battery Company, and made what report they pleased upon the belts and appliances. In 1893, in consequence of attacks upon the belts, he wrote to the College of Physicians, and all the medical bodies, offering to pay all the costs of a commission of investigation. He also wrote to the *Lancet*, asking them to inspect the premises and appliances. The names and particulars of every patient treated was entered in the books, which were now in Court. Three months after the treatment circulars were sent to the patients so that they could make any complaints or observations about the treatment. It was not all ready money business, because people, if known, were treated and trusted. They had a cheque book where the name of the bank was left blank to be filled in by the customer, but this book was very rarely used. Many of the highest people in England visited the Institute and were treated. Between May, 1889, and October, 1893, the Medical Battery Company sold about 89,000 belts and about 15,000 trusses. The books of the company would show about 30 complaints as to belts. The *Pall Mall Gazette* attack brought a few more complaints from people who had had the belts for years, worn them out, and then wanted their money back. It was in consequence of the *Pall Mall* attacks, and to protect the assets of the company, that the shareholders resolved to wind up. Witness had the whole of his money invested, every shilling of it, in this business. It was an absolute lie to say he had made a fortune. He had lost one by this blackmail. When this newspaper attack was made, the company received demands from its trade creditors, which forced the company into liquidation. Up to that time there had been no threat of criminal proceedings by Colonel Brasyer. Until the action was commenced by Colonel Brasyer, not a single word of complaint had

been received from Colonel Brasyer, or it would have been dealt with. Witness was arrested on a warrant at 10 o'clock at night on November 6th, 1893, at his private residence at Potter's Bar. He had been at business that day, and was not contemplating running away. He was brought back to London and locked up all night. He was taken to Holloway, and not bailed until 5 o'clock the next afternoon. He had lived at Potter's Bar for seven years.

The hearing was adjourned until Wednesday morning.

Mr. C. B. Harness, in further examination on Wednesday, said this litigation had meant total ruin to him.

Cross-examined by Mr. Witt, Q.C., the Witness said as a youth he began his commercial career with Messrs. Silber & Fleming, a firm of merchants in the City. He was first a salesman and afterwards warehouse walker. He was proud of his early life. He admitted that he had never studied surgery or medical science. He did not know anything about anatomy.

Do you know anything about pathology?—Nothing of importance.

Do you know what pathology is?—Oh, yes; it is the study of medicine. (Great laughter.)

Witness admitted that he knew nothing of the science of the causes of disease. He did not pretend to be a scientist at all. He was only the practical administrator of the affairs of the company. He had not studied chemistry in association with therapeutics; he was surrounded with a staff, and he simply administered it.

Are you not the author of a number of books on electro-therapeutics?—No.

But the works bear the name of C. B. Harness?—The rivalry of other businesses made it necessary to identify all the publications and wares of this business with the name of Harness.

Do you, or do you not, pretend to understand the action of these belts you sell?—Yes; in a degree I do—there are degrees in the study.

Now this belt (produced) has on it discs of zinc and discs of copper?—Yes, copper silvered.

Did you pretend to sell your belts with a connecting wire between the zinc and copper discs?—Yes, connected, for about seven years.

After that, unconnected?—Afterwards, by authority of the French School of Medicine, unconnected.

When did you leave off selling the belts unconnected?—The first agreement with the French doctors was, I think, in 1888.

Why did you make that alteration?—Simply we were instructed to do so by Dr. Lorean, Dr. Vigouroux, and the Commission of the French Government of 1886. I believe, now, they are better unconnected. The French electricians proved that the belts were better unconnected.

Was not the real reason because the connected belts raised sores on the patient's body?—No. We went deeper into science, and our experience was different.

Do you know that perspiration from the body is sufficient acid to produce an electric current?—Certainly.

Do you know that it is an acid sufficiently powerful to act upon zinc?—Yes.

If a belt is worn next the body and the zinc discs are connected with copper discs, don't you know that the current of electricity necessarily produces sores on the body?—Very slight. That shows the electricity enters the body.

Do you say that any electric current can be produced in a belt unconnected?—I do, and I am prepared to prove that the unconnected belts are best. I disapprove of the connected belts which the company are now selling. I have, now, no connection with the company. I have been convinced by experiments that the unconnected belts are best. The connected belts are more superficial in their action. The unconnected belt is more profound in its medical action when the current enters the body.

Are you quite sure that a different statement has not appeared in your pamphlets within the last three years?—I do not think it has appeared; I have not noticed it.

Has not this pamphlet (produced) been in use on your counters within the last three years?—It might have been issued, but I did not approve of it.

I want to know whether, on the alteration of your opinion, you suppressed these pamphlets, and published that they were wrong?—We did not say they were wrong; we published what we considered was then right. A man has a right to alter his opinion in 12 years, if he has good authority.

Did you not make these unconnected belts because experience showed that sores were created on the human body by the connected ones?—No; because sores can be created both by the connected and the unconnected belts.

Mr. Witt: Now, listen to this: "All that the public need bear in mind, to prevent their being swindled, is that there can be no galvanic current produced unless there are two metals suitably connected and an exciting medium." What do you say to that?—Those were my views six years ago.

Don't you know, now, that a more true proposition than those four lines never was made?—No. I say that is wrong, so far as the curative apparatus is concerned. I say that from my experience.

Do you say that a galvanic current can be generated where there is no connection between the two opposing metals?—I do. I go further than that, and say we can produce it from one metal on the body.

How much do these belts cost your company?—From 10s. to 15s. each. They are only made in small quantities, and therefore they are more expensive. The balance-sheets of the company prove the cost of everything.

I put it to you that the cost is very much less than that?—I say it is very much higher; there is the cost of fitting and measuring. Our prices were from one to five guineas, or the same prices as other belt manufacturers.

And your present proposition, as I understand, is that these unconnected belts have an electric effect which is of a curative character?—I have read, I have been told, I have referred the matter, and I have got copies of the Commission in Paris in 1886, and the most learned doctors have laid down this proposition; and to-day I say I am quite correct, and have evidence in Court to prove it.

Then you fix yourself with the proposition than an electric current is set up in these unconnected belts?—I do; and I go further and say that from one metal alone an electrical current is set up.

Oh, don't go further?—I do, because that is the dispute.

Do you say that this electric current that you speak of passed into the interior of the body?—Yes, right through the body, and all over internally.

Then the skin is not a sufficient resister?—No, certainly not.

The witness was then taken to the subject of the blank cheque book. Mr. Witt asked, "How many of these blank cheques were filled up and used in the way explained between 1885 and October, 1893"?—Mr. Harness "should say a very few."

But you can easily know?—No, I have no dealings with the company's finances either directly or indirectly.

But these books have been accounted for?—People sometimes used to offer a cheque on plain paper. I thought that dangerous and suggested these cheque forms, but I did not myself order them.

Mr. Witt wanted to know how many of these forms had been used. The Witness could not say. The learned counsel suggested "thousands," but the witness dissented.

"Were the forms numbered," asked Mr. Witt. "Probably," answered Witness.

Do you mind looking at this one. What is the number?—2,007. I think that is not the accurate number, but only a mode of number to make it look larger. That is often done in business houses.

The Judge asked if this form was the one he had in his hand yesterday.

Mr. Witt: No, my lord. The one yesterday was 4,000.

Witness said it was a wrong number. The counterfoils of the cheques were in the hands of the liquidator of the company.

Mr. Witt handed to witness a document, and asked if it came from the Medical Battery Company. Mr. Harness admitted that it did.

Mr. Witt then read the document as follows: "Notice before issuing County Court plaint. Take notice that unless you pay or remit to us £3 5s., due to us on account, particulars of which have been delivered to you, on or before Saturday next, February 4th, we shall cause a process to be issued against you, pursuant to the Act of Parliament for facilitating the recovery of small debts."

Witness said that form was used after a person had owed the company money for probably 12 months.

Was not that notice sent out in hundreds and hundreds of cases?—No; but in the course of 12 years we may have sent out a few hundreds.

The one I have in my hand is No. 710?—Probably that is the right number. People obtained our goods, and we had the right to recover our money.

Is that a form authorised by you personally?—No.

You seem to know very little about your business?—I was aware that form was issued, if you wish me to take the responsibility.

Did you put the whole of your capital into this company?—Yes, and my family's too. I had about £11,000 in the company personally. My whole fortune was absolutely bound up in this company.

You have been involved in considerable litigation?—Yes; blackmailing litigation.

Let me draw your attention to one or two cases. Did your company bring an action against Messrs. Alabaster & Gatehouse, proprietors or writers in the Electrical Review?—Yes; that was an action for libel.

Did the defendants plead that their statements were true in substance and in fact?—I believe they did.

Did the Medical Battery Company discontinue that action and pay the defendants' costs?—Yes.

The learned counsel read the article which appeared in the Electrical Review, saying that the Harness appliances ought not to have been exhibited at the Electric Exhibition at the Crystal Palace, because the belts were made in opposition to the most elementary rules of electricity.

Did you not consider that these statements in the Electrical Review were very injurious to your company?—They were not only injurious; they were absolute lies.

Mr. Justice Charles: But, in the result, your company paid the costs of those persons who made these statements. Why did you decline fighting this action when serious charges are made against you?

Witness: We should have been practically ruined for money, and we thought it better to pay damages and close the affair.

Mr. Witt: Then there was an action for libel brought against you by Mr. Gatehouse for the circular you sent to the newsagents stopping the sale of the Electrical Review. Did that action come on before the Lord Chief Justice and a jury?—Yes.

And was Sir Edward Clarke your counsel?—Yes.

Did the jury return a verdict against you of £1,000 damages?—Yes.

Mr. Justice Charles: The net result is, that Alabaster & Gatehouse's action succeeded against the company, and the company paid Alabaster's costs in the other libel action. That was a triumph for Alabaster.

Witness: We were ruined, and could go no further.

Mr. Witt: Did the Medical Battery Company issue a writ against *Science Siftings*?—Yes, for practically the same libel.

The learned counsel proceeded to read the article published in *Science Siftings*. "Do you say, Mr. Harness, that that is all lies from beginning to end?"—"Yes," replied the witness, "from beginning to end."

Did you afterwards go with your solicitor to the office of *Science Siftings* and pay them £1,000, and £300 costs to drop the matter?—No. Our cheque was obtained from us by fraud.

But was £1,000 paid?—Yes; we were in the hands of blackmailers, and therefore they obtained our cheque.

Did someone on your behalf pay the costs as between solicitor and client, in addition to the the £1,000 damages?—I believe so.

If these were atrocious libels, as you say, why did you not go on with your action?—I could not control the company. We knew the proprietors could not pay if they were beaten.

Mr. Justice Charles: But the libels were of the strongest sort, and to the persons who published these libels it was thought expedient to give them £1,300.

Now we come to the series of articles in the *Pall Mall Gazette*. I will read them.—Witness: I do not think they are worth reading. They are as bad as can be. (Laughter.)

Witness: I issued a writ against the proprietor of the *Pall Mall Gazette* on October 28th. Five days after I was arrested, and the matter had to lay for three months.

Did the *Pall Mall Gazette*, in defence to your action for libel, plead that their words were true in substance and in fact?—Certainly. They and Mr. Gatehouse decided to wind us up in that way.

But you agreed to discontinue that action, and to pay their costs?—Yes. Their costs were very small.

Why did you not go on with that action?—Utterly impossible for want of funds, and they knew that. After three months' fighting in the police court, I could not fight a millionaire.

You did not doubt the solvency of the *Pall Mall Gazette*?—No. I knew the proprietor as one of the richest men in the world. I was ruined, and could not fight him. I have not failed. I have been practically murdered.

Is the ruin of the Medical Battery Company attributable to the articles in the *Pall Mall Gazette*?—Yes, it was a successful company until that date, but these articles proved its ruin. No bank could have stood them.

Had you sunk your whole fortune in this concern?—Yes, everything.

Have you really believed in this company?—Yes.

Do you believe all these dreadful charges made against you in these papers about being a swindler and a cheat are utterly unfounded?—Absolutely. I have offered Mr. Astor, if he wants to pose as a public benefactor, to go on with this action if he will find some of the money. As soon as I am in funds I will commence the action again. The writers of these articles in the *Pall Mall* were the same clique as has been attacking me for years. The creditors and shareholders of the company are reconstructing the company.

Is there any connection between this action and the reconstruction?—No; the company is absolutely opposed to my bringing this action.

Now, Mr. Harness, have you ever represented yourself as a doctor?—No, never.

Never represented yourself as "Dr." C. B. Harness?—Never in my life.

Re-examined by Mr. Jelf, the Witness said the majority of testimonials of the company were obtained voluntarily. The unconnected belts were found by the French School of Electricians to be better than the connected. If there were currents of electricity in the body without a belt, these unconnected belts gave the currents in the body greater force. The expenses of the Medical Battery Company were about £80,000 a year. The salary account came to £15,000. The prices for the belts were not raised if people seemed wealthy. The prices were always the same unless a person said they could not pay, and then sometimes they were treated for nothing.

M. Louis Loreau, of Paris, who gave evidence through an interpreter, said he was preparator of anatomy at the hospitals in Paris, and especially attached to the work of Dr. Charcôt at the Salpêtrière. He was introduced to Mr. Harness in June, 1888, and at Mr. Harness's suggestion he came over and took up his residence at 52, Oxford Street, to inaugurate improvements there similar to those in use in the Salpêtrière Hospital in Paris. He remained at Oxford Street until March, 1892, and introduced many improved appliances at considerable cost, similar to those used in the Paris hospitals, in Germany, and in Austria. It was not possible to injure a person's arm with the statical machine, as Col. Brasyer alleged. He could not say whether the unconnected belts produced electricity, but they produced physiological phenomena of great benefit in certain complaints.

The further hearing was adjourned to Thursday morning.

The case was resumed yesterday when the defendants called Messrs. Mackie, Joel, Fell, Loreau, Dr. Arthur Harries, and Dr. Harris to speak in favour of the belt from a scientific point of view. Two persons who had received treatment were also called.

(To be continued.)

MECHANICAL DRAUGHT.

I.

The production of the draught in a furnace, by other means than a chimney, progresses at a comparatively slow rate, and it would appear probable that this tardy growth is due very largely to the fact that in most cases a chimney must be used if only to carry off the furnace gases to a convenient height to avoid a nuisance, and the chimney serves also to produce the requisite draught. At the same time, in cases where a chimney of considerable height is really required it is still open to argument, indeed, very probable that it would pay to add a mechanical draught producer, and reduce the furnace gases to a very considerably lower temperature than that below which a chimney will fail to work satisfactorily. The whole question of mechanical draught is wrapped up in the possibility of reducing the furnace gases to a sufficiently low temperature to render the mechanical method a commercial success, for it is obvious that unless we are able to reduce the gases to some very considerable degree below the temperature at which the compulsory chimney will produce the required draught, we should be simply wasting money in making the addition. A chimney temperature of 400° is quite common. This is 350° above a normal atmospheric temperature, and probably represents a seventh of the total heat generated in the furnaces. Were it possible to abstract from the waste gases another 100° of temperature, or two-sevenths of the waste 350°, we should be saving two-sevenths of one-seventh of the total heat, or, say, 4 per cent., whereas the cost of a mechanically produced draught should not exceed one per cent. of the total horse-power of the plant, showing a saving of three per cent. with the data assumed.

Obviously, however, the reduction of the waste temperature can only be effected by means of a heat-absorbing surface at a temperature very much lower than the boiler surfaces, and this applies with even greater force to-day than it did some years ago, before steam pressures were so high and when boiler temperatures were therefore less.

The great uncertainty of a chimney-produced draught makes itself particularly felt when the atmosphere is loaded with water vapour, the low specific gravity of which reduces the chimney effect very seriously in such cases as are already working up to the maximum of which the chimney is capable. To such, a fan draught is specially applicable. The extended heat-absorbing surface, stated above as necessary to reduce the waste gases by something more than the amount to be expended upon the driving of the draught machinery, must, obviously, be applied in the form of a feed water heater, and, in addition, if it can be arranged, of an air heater also to heat the air going to the furnace.

It is an old saying that to heat the air supply of a furnace is to reduce the efficiency and it may be that such was the case, though it is a little difficult to trace out the reason for this. With a fan draught, however, where the heat is applied to the air after the fan has done its work on it the conditions will be different, and it may be that in heating the air going to the furnace by the waste gases passing from the furnace we shall find the means of abstracting the last few degrees of temperature practically possible without introducing the known disadvantages which accrue when cold water pipes are brought into contact with the furnace wastes, namely severe corrosion of the pipes. The use of the flue feed heater, or economiser, is, of course, imperative if fuel economy is to be considered, and with a fan draught is still more essential. The very serious retardation of the draught that is produced by the economiser is, no doubt, due to the fact that the waste gases are required to pass through a series of rows of pipes 6, 8, 10 or 12 in number, so that there is introduced several times the wall friction which prevails in an unobstructed flue, and for chimney draughts the economiser is often too narrow and too long, and would be better if made wider and shorter, so as to compensate by cross-section and slower travel of the gases for the increased skin friction. Very usually, however, the width of the economiser is fixed by conditions beyond present control; but with a fan draught a slight extra speed of fan will make up for any unavoidably introduced obstructions, so that in every way the use of fans to produce draught for steam boiler furnaces is a question that is worthy of very serious consideration. Even where a chimney of some height is compulsory it may be of less size than otherwise necessary, though it should be noted that flues of large area throughout tend to the easy working of a fan, and every reduction of area adds to the power absorbed in turning the fan.

(To be continued.)

NOTES.

Exhibition at Worcester.—It is proposed to hold an electrical exhibition in the Public Hall in October next, under the direction of the Watch Committee.

Telephonic Communication.—Monday next has been provisionally fixed for the opening of the telephone trunk line between Scarborough and Leeds.

Electric Light at Derry.—There was a failure of the electric lamps in certain portions of the city last Friday night, necessitating the lighting of the gas lamps.

New Book.—A new book, entitled "American Electric Street Railways, their Construction and Equipment," by Mr. Killingworth Hedges, is shortly to be published by Messrs. Spon.

Bowling by Electricity.—The Bradford Bowling Club, in its enthusiasm for the game of bowls, has had the green lighted by arc lamps, and the game can now be continued till the sma' hours.

Messrs. Gordon and the Lighting of Larne.—The chairman of the Town Commissioners stated on Monday that they had for the second time entered into a contract with Messrs. Gordon & Co. for the lighting of the town by electricity.

The New Atlantic Cable.—The steamer *Faraday* completed the laying of the Commercial Cable Company's third Atlantic cable on Monday. The insulation was perfect. During the laying of the cable no hitch of any kind occurred, but operations were much impeded by dense fogs.

The Lighting of the Embankment.—In consequence of the County Council Works Committee declining to carry out the electric lighting of Westminster and Waterloo Bridges, and the Thames Embankment, on the ground that the estimates of the Highways Committee were too low, a proposal was made by the latter committee that the work should be put out to tender. This will be considered next week.

Birmingham Saved from the Spoilers.—The picturesque and classic streets of Birmingham have been saved from the hands of the spoilers. A Committee of the City Council will not permit the Central Tramways Company to erect the overhead system. In their own words, "It was their duty to protect them (the streets) from the hopeless spoliation and disfigurement which acquiescence in the company's application would have involved." We think this beats Glasgow's objection to the nude in art.

Cable Festivities.—The 25th anniversary of the establishment of cable telegraphic communication with the Far East is to be celebrated by a banquet at the Imperial Institute, on Friday, July 20th, to be attended by gentlemen representing every section of the British Empire. More than 500 guests will be present at the banquet, which is to be followed by a reception and garden *fête*, for which several thousands of invitations will be issued. The buildings and grounds will be specially arranged and illuminated for the occasion, which promises to be one of the most brilliant functions of the present season. Invitations to the reception state that guests are to have the honour of meeting the Prince of Wales, who, it is expected, will be accompanied by other members of the Royal Family. A very interesting feature of the celebration will be the display of cable telegraphic instruments in working communication with the four quarters of the world. The instruments will be used by the Prince of Wales during the evening for the despatch of messages to the Governors of the various British colonies and dependencies, and for receiving replies thereto.

Church Electric Lighting.—It is proposed to light St. Mary's Church, Barrow, with electricity.

The Lighting of Ayr.—We understand that Messrs. Crompton, the Brush Company, and the Electric Construction Company, declined to tender for the lighting of Ayr.

Harrow Electric Lighting.—From some correspondence appearing in the local papers, it appears that the ratepayers have petitioned the Local Board to call a general meeting before they proceed with the electric light scheme, and the Board have fallen in with the suggestion.

Canterbury and Electric Lighting.—At a public meeting last week, it was decided that it was desirable to have the electric light in the city, and a committee was appointed to consider how the necessary capital can be raised and the probable support the scheme will receive.

The Tower Bridge.—This pride of London, which was formally opened to traffic only last Saturday by distinguished Royalty, is already in a measure old-fashioned, for the bridge and its approaches are lighted entirely by gas. Surely there must have been some oversight in leaving electricity out of the question, especially now that it is in such extensive demand in the metropolis.

The New Pacific Cable.—The Inter-Colonial Conference at Ottawa was, on Monday, engaged in the discussion of the Pacific Cable question, which was brought forward by the Hon. F. B. Suttor (New South Wales). A paper was read by Sir Sandford Fleming, in which he submitted proposals for the construction of the cable under an Imperial and Colonial guarantee.

Southampton Electric Lighting.—At last week's meeting of the Town Council, the Works Committee recommended that it was desirable that the Council should purchase the company's undertaking, and asked the Council to appoint a committee to confer with the directors on the subject. After considerable discussion the matter was referred back to the committee for further particulars.

Royal Institution of Great Britain.—Mr. Ludwig Mond, F.R.S., has made a proposal to the Managers of the Royal Institution of Great Britain to convey to the members of that Institution the freehold of No. 20, Albemarle Street, to be held by them for the purpose of a laboratory to be named "The Davy-Faraday Research Laboratory of the Royal Institution," and for the purpose of providing increased accommodation for the Institution. The managers, at their meeting on the 2nd inst., most cordially and gratefully accepted this munificent gift.

Landline Communication with India and the East.—A notice just published by the Berne Bureau International des Télégraphes throws a light on the state of one of the landlines between Europe and India. We learn that in consequence of the serious floods prevailing for the last six months, and which are due to the overflowing of the Tigris and of the Euphrates, a great portion of the region of Mesopatamia, through which the landline from Bagdad to Fao passes, has been under water. Since this state of affairs began, the Turkish Government has taken the necessary measures to repair any breakdowns, and has spared no sacrifice to maintain the communication in its normal state. In spite of the continuation of the floods, this work is actively carried on, and it is hoped that this line will soon be restored to good condition. To obviate any prolonged delay in messages passing *viâ* Fao, telegrams are carried by native boats at those points where the line is submerged. Notwithstanding this, it happens that such means of maintaining communication is impracticable, owing to variations in the inundation, rendering a reliable service impossible.

Northern Society of Electrical Engineers.—Arrangements have now been completed for an excursion to the Antwerp Exhibition. A special saloon carriage will be attached to the train leaving the London Road Station, M. S. & L., Manchester, at 3 p.m., on Friday, July 20th, arriving at Harwich at 9.20 p.m. The party will embark on the steamer which leaves Harwich (Parkeston Quay), at 10.15 p.m., and arrives in Antwerp at 10 a.m. Saturday. The party will return from Antwerp at 6.45 p.m. on Monday, July 23rd, arriving in Manchester at 3 p.m. the following day. Those members who do not find it convenient to travel from Manchester can join the party at Harwich. Friends of members wishing to accompany the party may be introduced according to No. XXVI. of the "Rules and Regulations." Messrs. Thomas Cook & Sons are arranging for hotel accommodation.

How to Mend an Incandescent Lamp.—Writing from Rome recently to the *Scientific American*, F. Haushahn says: "'T. R. E.,' in query 5,978, date April 28th, 1894, asks how to mend an incandescent lamp when the wires are blown off close to the glass. I mended a small lamp of the Swan type by filing off the glass (with an ordinary steel file) close to the broken wire, making a right-angled cut, then carefully bending the projecting piece of platinum wire into a small hook; round this I lashed some thin platinum wire, so as to form a loop to take the place of the broken one. These loops can be easily fitted in the two bent wires in the holder, taking the precaution of pressing back the spring wire when inserting the lamp. I advise 'T. R. E.' to buy lamps in which the glass neck is surrounded by a metallic ring, the space filled with some insulating material, out of which two strong copper wires, soldered to the platinum wire, project. These wires are twisted several times into a loop. This kind of lamp, as I know from experience, can stand almost any kind of rough treatment."

NEW COMPANIES REGISTERED.

Commercial Electricity Supply Company, Limited (41,498).—This company was registered on the 30th inst., with a capital of £2,000, in shares, to carry on the business of a company for the supply of electricity in all its branches, and to carry on the business of electrical and mechanical engineers. The subscribers (with one share each) are:—A. E. Cossor, 96, Hillfield Road, N.W., gentleman; A. J. McGrath, 70, Victoria Road, N.W., clerk; G. W. Whitton, 60, Queen Victoria Street, E.C., engineer; R. A. Daniell, 20, Bucklersbury, E.C., solicitor; F. G. Nash, 73, Salcott Road, S.W., solicitor's clerk; E. Baunan, 57, White Horse Lane, Mile End, artist; S. G. Tripp, 28, Wilberforce Road, N., engineer. Registered office, 3, Victoria Street, S.W.

Windermere and District Electricity Supply Company, Limited (41,461).—This company was registered on the 27th inst. with a capital of £50,000, in £5 shares, to carry on the business of electrical engineers, electricians, contractors, suppliers of electricity, and manufacturers of electrical apparatus. The subscribers (with 1 share each) are: M. E. Sheerboom, 6, Ferncliffe Road, N.E., clerk; A. Barrenger, 40, Wightman Road, N., clerk; T. F. Bickford, 22, Haygard Road, Twickenham, solicitor; J. Renwick, 29, Hillside Road, N., clerk; A. Hair, 14, Upper Park Road, N.W., solicitor; H. E. Shaughnessy, 39, Bramah Road, S.W., accountant; F. Hodson, 161, Kennington Road, S.E., accountant. There are not to be fewer than three nor more than seven directors; qualification, £500; remuneration, £500 per annum, divisible. Registered office, Frentbeck Bridge Mills, Windermere.

Great Western Electric Light and Power Company, Limited (41,489).—This company was registered on the 29th ult. with a capital of £1,000 in £10 shares, to produce and supply electricity or electrical currents or force, and to undertake public or private lighting. The subscribers (with one share each) are:—H. Simmonds, 73, St. George's Avenue, N., book-keeper; W. Farrant, 7, Vincent Square, S.W., civil engineer; R. Bridges-Molesworth, 34, Victoria Street, E.C., civil engineer; A. H. Witham, 49, Crewdson Road, S.W., shorthand clerk; E. A. Watts, 74, Offord Road, N., clerk; E. L. Russel, 2, Thornford Road, S.E., clerk; A. G. Defries, Rose Bank, Bulwer Road, Leytonstone, clerk. Registered by Walter Webb & Co., 23, Queen Victoria Street, E.C.

Wimshurst, Hollick & Co., Limited (41,466).—This company was registered on the 27th inst. with a capital of £40,000, in £5 shares, of which 4,000 are preference and an equal number ordinary, to acquire and take over as a going concern the business of electrical and general engineers and boiler makers, carried on by the firm of Wimshurst, Hollick and Co., at 602—4, Commercial Road, E., and elsewhere, and to continue this undertaking in every way. The subscribers (with 1 share each) are: T. D. Hollick, 602, Commercial Road, E., engineer; S. R. Nollick, 2, Great Scotland Yard, S.W., agent; F. W. Drake, Oakleigh, Bracknell, Berks, merchant; T. F. Hollick, 602, Commercial Road, E., engineer; L. P. Drake, 21, Blomfield Street, W., spinster; G. Willson, 16, New Burlington Street, W., solicitor. The first directors are T. P. Hollick, T. D. Hollick, and F. W. Drake; qualification, £1,000; remuneration to be fixed in general meeting. Registered by Geo. Willson, 16, New Burlington Street, W.

Alfred Herbert, Limited (41,507).—This company was registered on the 2nd inst. with a capital of £25,000, in £5 shares, to carry on the business of mechanical engineers, brassfounders, metallurgists, suppliers of electricity, electrical engineers, millwrights, electroplaters, &c., and to undertake the business formerly carried on by A. E. Herbert, at the Butts, Coventry. The subscribers (with one share each) are: W. H. Herbert, Fairhill, Coventry, manufacturer; W. Herbert, 88, Regent Road, Leicester, gentleman; S. A. Herbert, 88, Regent Road, Leicester; F. M. Herbert, Fairhill, Coventry, married woman; E. A. Herbert, Earlsdon, Coventry, married woman; A. E. Marston, 4, Grosvenor Villas, Coventry, manufacturer; F. M. Marston, 4, Grosvenor Villas, Coventry, married woman. There are never to be fewer than two, nor more than five, directors; qualification, £500; remuneration not yet determined. Mr. A. E. Herbert is to be one of the first members of the board. Registered by Waterlow Brothers & Layton, Limited, 24—5, Birchin Lane, E.C.

BUSINESS NOTICES, &c.

The Electric Lighting of the Victoria Embankment.—The Highways Committee of the London County Council have reported that they had considered the general description and specification of the engines, boilers, dynamos, and other machinery and plant which would be required for the generating station in connection with the electric lighting of the Victoria Embankment and Waterloo and Westminster Bridges, and had also had submitted to them an estimate of the cost. It appeared to them advisable that the supply of this machinery and plant should be the subject of two separate contracts, the one relating to the boilers and accessories, and the other to the engines, dynamos, &c.; and that, having regard to the extreme importance of the electric light installation being completed and in operation before the end of the year, tenders should be invited without any avoidable delay. They therefore recommended "that, subject to an estimate being submitted to the council by the Finance Committee as required by the statute, the machinery and plant for the generating station required for the electric light installation for the Victoria Embankment and the Waterloo and Westminster Bridges be obtained; and that tenders for the supply of the said machinery and plant be invited by public advertisements." The consideration of the report was adjourned for a week. The Highways Committee further reported that a notice had been given by the City of London Electric Lighting Company of their intention to lay mains across the Victoria Embankment at four points, namely, Temple Avenue, Carmelite Street, and each side of John Carpenter Street, and to connect the new mains with those in the subway of the Embankment. They saw no objection to the sanction of the council being given, subject to proper conditions, to the works proposed, and recommended that the sanction of the council be given to the works referred to, upon certain conditions.

Ilfracombe Lighting.—The Great Western Electr Light Company of Bristol will apply for a lighting order.

Bedford and Electric Lighting.—The following is the list of the tenders that were sent in for the Council's electric lighting, and those marked with an asterisk were recommended for acceptance by the committee, though in two of these cases it was found desirable to make alterations in consequence of information obtained by the committee since issuing their report:—

Mains and Transformers.

	£	s.	d.
Pritchetts & Gold	3,465	10	0
Porter & Harrison	3,350	0	0
New & Mayne	3,282	2	6
Brush Electrical Engineering Company, Limited	3,068	0	0
Electric Construction Company, Limited ...	2,780	0	0
British Insulated Wire Company, Limited ...	2,686	10	5
India-Rubber, Gutta-Percha & Telegraph Co., Ltd.	2,598	0	0
J. Fowler & Co., Limited (Leeds)	2,560	0	0
Glover & Co.	2,520	15	0
Henley's Telegraph Works, Limited	2,463	16	8
Hooper's Telegraph & India-Rubber Works, Ltd.	2,450	0	0
Johnson & Phillips, London	2,416	4	0
Crompton & Co., Limited	2,333	0	0
Telegraph Manufacturing Company, Limited ...	2,271	5	2
*Siemens Bros. & Co., Ltd. (incomplete tender) ...	2,215	0	0

Plant.

Bailey, Grundy & Barrett	9,320	0	0
Siemens Bros. & Company, Limited (London) ...	6,290	0	0
J. Fowler & Co., Limited (Leeds)	6,123	0	0
Brush Electrical Manufacturing Company, Ltd.	5,890	0	0
Crompton & Co., Limited	5,791	0	0
Allen, Son & Co. (Bedford)	5,731	0	0
Electric Construction Company, Limited ...	5,317	0	0
*Johnson & Phillips (London)	4,888	0	0

Buildings and Shaft.

G. E. Fathers (Bedford)	2,022	13	6
J. J. Potter (Bedford)	1,911	0	0
*T. H. Coleman (Bedford)	1,565	0	0

Travelling Crane.

Bedford Engineering Company	120	0	0
*Messrs. Grafton & Company (Bedford)	85	0	0

Mr. Blaydes at last week's meeting of the Council said the committee felt there was no time to lose and that it was essential, if they wished to carry out electric lighting this year, to push the matter on as quickly as possible. Consequently when they met to consider the tenders they approved of those which were recommended in their report for acceptance. Since then, however, something had transpired which rendered some alterations necessary. In the case of Messrs. Siemens Bros.' tender, that was accepted provisionally by the committee on the understanding that a proper bill of quantities would be sent in. Siemens Bros. was the only firm who failed to send in a bill of quantities with their tender, and it only arrived that morning. The committee had looked through it and found that the effect of it would be such that if they recommended it they would be asking the Council to accept a tender which would not be to the best advantage of the borough. This tender was recommended on the assumption that the bill of quantities would be satisfactory when received, but on examining it that morning they found that the price per yard multiplied by the number of yards to be done would give a total considerably in excess of the amount of the tender. The next lowest was only £65 more than the original tender of Messrs. Siemens Bros., and he therefore moved that the tender of the Telegraph Manufacturing Company for £2,271 5s. 2d. be accepted. This having been seconded was unanimously agreed to. Messrs. Johnson and Phillips's was the next tender accepted, and this was £5,200 instead of £4,888, the increase being caused by a different engine than that specified being required. Mr. Coleman's and Messrs. Grafton's tenders were also accepted as marked on the list above.

On Friday, last week, a Local Government Board inquiry was held regarding the borrowing of £12,000 for carrying out the work.

Application for Extension of Patent Period.—In the *London Gazette* for Tuesday last appeared a notice to the effect that it is the intention of the Electric Construction Company, Limited, to whom the undermentioned letters patent have been assigned, and the Electrical Power Storage Company, Limited, of 4, Great Winchester Street, in the city of London, who are exclusive licensees under the said letters patent, to present a petition to Her Majesty in Council, praying that the said letters patent may be extended for a further term. On August 13th, or on such subsequent day as the Judicial Committee of Her Majesty's Privy Council shall appoint for that purpose, application will be made to the said Committee for a time to be fixed for hearing the matter of the said petition, and any person desirous of being heard in opposition to the said petition must enter a cavent to that effect in the Privy Council Office, on or before August 13th. The following are the patents referred to:—"In the matter of letters patent, granted to John Henry Johnson, of 47, Lincoln's Inn Fields, in the county of Middlesex, gentleman, for an invention of 'improvements in galvanic polarisation batteries or magazines of electricity, and the application of the same, and in apparatus connected therewith'—a communication from abroad by Camille Faure, of Paris, in the Republic of France—bearing date January 11th, 1881, and numbered 129, the title and specification of which letters patent have been duly altered and amended by disclaimer and memorandum of alteration filed January 10th, 1882, and which title as so amended is 'improvements in galvanic polarisation batteries or magazines of electricity.'"

Electric Lighting in Manchester.—A report of the Electric Light Department of the Manchester Corporation for the year ended March 31st, 1894, has been prepared. The buildings, boilers, engines, dynamos, and other plant referred to in the report of last year have been completed, and the supply of current was commenced on July 31st, 1893. The number of consumers at the close of the year was 412, and the number of incandescent lamps in use was 18,478, arc lamps 250, and 11 motors representing 16 horse-power. The total quantity of current supplied and charged for was 439,379 units, and the amount of revenue from both methods of charge, including fixed charge per lamp and rate per units consumed, was £10,067 7s. 4d., which works out to about 5½d. per unit. The amount for which borrowing powers have been obtained is £150,000, and of this sum £127,830 has been borrowed. The amount of capital expenditure to March 31st, 1894, less £610 16s. 3d., being interest on loans during construction transferred to revenue account, was £127,374 11s. 4d. The total amount of revenue from sales of current and rental of meters was £10,198 11s. 7d. The cost of generation, distribution, and management as set forth in abstract No. 3 was £5,509 16s. 4d., to which amount must be added for interest from the commencement of the undertaking, £3,461 6s. 7d.; bankers' commission, £60 9s. 11d.; and sinking fund, £1,376 17s. 7d.; leaving a debit balance of £209 18s. 10d. to be carried forward to next year's account. The generating plant in operation was estimated to supply an average of about 20,000 16-C.P. incandescent lamps, and to be quite equal to any demand which would be likely to be made upon it for two years or more. So numerous, however, have been the applications that the plant is already loaded to its full capacity, and it was found that without extension there would be difficulty in fully supplying the demand for next winter. Under these circumstances it was decided to extend the plant by the following, namely, one Lancashire boiler, two 360 horse-power vertical compound condensing engines, and two large dynamos. These works are now in progress, and will be available for next winter. The new offices, workshops, and storerooms are also rapidly approaching completion. The applications for a supply of current outside the present area are so numerous that the Committee have decided to make inquiry, and on a future day to report to the Council as to the desirableness of laying mains in certain leading thoroughfares, and of providing the additional plant and machinery required to generate the current, for which there is every probability of a great demand.

Price Lists, &c.—Messrs. Swinburne & Co., of Teddington, have sent us a copy of a supplement they are bringing out to accompany their catalogue. Motor alternators, direct current dynamos, switchboard instruments, electrostatic voltmeters, transformers, and high tension switches are among the articles referred to, all of which are illustrated.

From Messrs. J. P. Hall & Co. we have received one of their new dynamo price lists. This list is nicely set out and beautifully illustrated, chiefly by wood engravings. Being printed on extra good paper, some of the blocks show up excellently. Various sizes of compound-wound, shunt-wound, series-wound dynamos are described in detail, as are also dynamos and other plant for ship lighting, and the electric pumping plant at Jubilee Colliery, Shaw. A larger block illustrates the interior of the Oldham Corporation central electric lighting station.

A copy of the latest catalogue of the Leeds and London Electrical Engineering Company's manufactures is before us. As in previous lists, the Lowrie-Hall system of generation and distribution of electricity for light and power is described and illustrated in detail. The paper, blocks, and printing are first class, and altogether the book is an excellent production. There are included in it several new features, among these being alternators, and continuous current machines, and other apparatus for high tension alternating current supply.

Baxendale & Co.—This firm have secured the following among other contracts:—Denbigh Lunatic Asylum, telephonic communication; J. & R. Brown, Market Street, Manchester, incandescent lighting; Mrs. Astin, Market Place, Manchester, incandescent lighting; the Manchester Pantechnicon, Manchester, incandescent lighting; M. A. Shepley, Yorkshire Street, Oldham, arc and incandescent lighting; Stirling & Co., Market Street, Manchester, arc and incandescent lighting; Slater's Directory Offices, King Street, Manchester, incandescent lighting; Messrs. Partlett & Co., Oxford Street, Manchester, telephonic communication; Messrs. Bancroft & Co., Dickinson Street, Manchester, telephonic communication; also the North Pier, Blackpool, arc lighting. The last named work is being carried out with concentric wiring, the cables employed being of the well-known paper insulation class manufactured by the British Insulated Wire Company, Prescot. The arc lamps are of the Brockie-Pell standard type.

"Why not go to Switzerland this year?"—With this title a neat, handy, and interesting pamphlet has been published by the Jura-Simplon Railroad Company. The chief fascinating features of this enchanting part of the continent are described in a pleasing manner and the nicely toned illustrations will remind those who have visited the country of a few of the attitudes necessitated and pleasantries indulged in, such as mountaineering, hunting, sleighing, &c., during a sojourn there. We recommend any of our readers who contemplate visiting Switzerland this year to write to the Jura-Simplon Railway Company for a copy of this pamphlet.

Walthamstow Electric Lighting.—At the recent meeting of the Local Board a letter was received from a Mr. Jerram informing the board that a syndicate had been formed for supplying electric light in the parish, and asking the board for permission to open the roads for laying down the necessary wires, and also desiring to know whether the board would use the electric light for street lighting at the same cost, or less, than they paid now for lighting. The letter was referred to the light committee.

The Llanberis-Snowdon Electric Railway. — The electric railway from the village of Llanberis to the summit of Snowdon, which has for some time past been spoken of, is likely to be soon constructed. A number of surveyors have measured the route, which covers a distance of over six miles, starting from near the Royal Hotel, past the celebrated Llanberis waterfall, then turning on the left and along the tops of the mountains on the west side of the Pass of Llanberis, after which the line will turn to the right, and proceed as far as the Crosses; then, after running along the mountain side opposite the Snowdon Ranger path, it will turn to the left and proceed direct to the top of Snowdon. It is stated that a limited company is about to be formed to carry out the scheme, and that already half the capital required has been secured.

Aberdeen Electric Lighting.—The Gas Committee last week resolved to recommend that the price to be charged for the electric light for the streets should be 3¾d. per lamp per hour. The convener stated that the original estimate of the cost of erecting the electric lighting station, laying down the plant, &c., was £25,000, but as the expenditure did not come up to the estimate the committee asked power to borrow only £20,000. It was now found necessary, however, to borrow the other £5,000. The electrical engineer (Mr. Murray) was asked if it was correct that he had recommended, in connection with the new police buildings, that it would be advisable to put in gas pipes in addition to the electric lighting apparatus. Mr. Murray stated that he had never advised any such thing. He saw no necessity for gas pipes being put into any building, if it had been decided to use the electric light. There was absolutely no risk of the electric light breaking down.

Electric Light at Dover. — The Dover Electricity Supply Company has lately sent out circulars to householders in the districts affected, together with forms of application for service. The mains will first of all supply the sea-front from Esplanade to East Cliff Terrace, Camden Crescent, Liverpool Street, New Bridge, Bench Street, King Street, Market Place, Cannon Street, Biggin Street, High Street, Snargate Street, Northampton Street, Commercial Quay, Custom House Quay, and Clarence Place. Should a sufficient demand arise mains will also be laid in Maison Dieu Road, Park Street, Pencester Street, Castle Street, Laureston Place, Castle Hill Road, and Victoria Park. The price to be charged is 8d. per Board of Trade unit, as a minimum charge of 13s. 4d. per quarter.

Electric Light in the City.—At the meeting of the Commissioners of Sewers on Tuesday, Mr. Turner asked for information on the subject of two recent failures of the electric light, and moved that a return of all such failures should be placed on the table at each meeting of the commission. This proposition having been seconded, was carried. The engineer said he had some information as to a failure of the electric light on the 12th ult., when eleven lamps failed, and it was reported to be due to the fact that some oil had run on the carbon, and it had not been noticed by the lamp trimmer. The other failure, on the 14th ult., was due to the breaking of a lamp.

Nalder Bros. & Co.—The partnership hitherto subsisting between F. H. Nalder, H. Nalder, C. W. S Crawley, and A. Soames, carrying on business under the style or firm of Nalder Bros. & Co., has been dissolved, by mutual consent, as and from the 24th day of June, 1894, so far as regards the said H. Nalder, who retires from the firm. All debts due to and owing by the said late firm will be received and paid by the said F. H. Nalder, C. W. S. Crawley, and A. Soames, who will continue the said business as heretofore.

Glasgow Electric Lighting.—The property owners of Union Street have suggested to the authorities that electric lamp pillars be erected in the centre of the thoroughfare. As the suggestion has been already considered by the Electric Lighting Committee of the Corporation and dismissed by them on account of its inexpediency and impracticability, owing to the tramway lines there, the authorities have resolved not to entertain the idea meantime.

Wrexham and Electric Lighting.—The corporate common seal was last week affixed to the joint memorial from the Wrexham and District Electric Supply Company, Limited, and the Corporation to the Board of Trade, in reference to the proposed acquisition by the Corporation of powers of electric lighting within the borough. It was stated in the memorial that the price to be paid is £350.

J. P. Hall & Co.—This firm have just satisfactorily completed, among other work, electric light installations for the Manchester Ship Canal Company, at the locks at Barton, Irlam and Latchford. The installations each comprise arc lamps, dynamos, steam engines, boilers, &c., and are carried out in a first-class manner. They have also completed the Oldham central electric supply station.

Business Announcement.—We are asked to state that the firm of Messrs. Habgood & Smith, of Queen Victoria Street and Great Missenden, are in no way connected with the British Volta Electric Glow Lamp Company, of 49, Queen Victoria Street and Great Missenden. Some misapprehension is abroad as to the two firms being connected.

Electric Light at Brighouse.—The Brighouse Co-operative Society's Central Stores have lately been lighted by electricity by Mr. A. B. Brook. A number of arc and incandescent lamps of various C.P.'s are distributed throughout the various departments and yards. The plant consists of a gas engine driving a dynamo supplied by Messrs. Fairburn.

Electric Cooking at the Agricultural Show. — The luncheon which was served in the Royal Pavilion at the Agricultural Show last Tuesday week was cooked by electricity. Messrs. Baily, Grundy & Barrett, Limited, of Cambridge, supplied the necessary apparatus.

Warning.—We hear of several cases in which goods have been obtained lately by a person who passes as a representative of well known firms, without any authority, and we would suggest that firms should not supply goods to anyone without their official order.

Athletic Sports at Chelmsford.—The fifth annual bicycle and athletic race meeting in connection with the Arc Works Athletic Club was held at Chelmsford last week. Messrs. Crompton, Albright, and Reeves were among the company present.

Bennett & Druce.—This firm have secured the order for a complete plant consisting of engine, dynamo, and fittings for a mill situated in the north-west provinces of India. The engine is by Messrs. Marshall, Sons & Co., Limited.

Asylum Electric Lighting.—The lunatic asylum at Upton (Cheshire) is to be enlarged and improved at a cost of over £75,000, £2,000 being set apart for electric lighting.

John Bolding & Sons, Limited.—This company have received instructions to instal the electric light at Mr. Clarke's new buildings at Bayswater, W.

Woodhall Spa and Electric Lighting.—A project is said to be on foot to form a company to supply Woodhall Spa with the electric light.

CONTRACTS OPEN AND CLOSED.

OPEN.

Blackwood (Mon.) — Tenders for a suitable plant for electrically lighting a foundry and engineering works. Apply Stewart, Blackwood, Mon.

Wolverhampton.—For electric wiring and erection of selected fittings in the Town Hall, Art Gallery, School of Art, Free Library, and Market Hall, for the Lighting Committee. Specifications, &c., to be obtained from Mr. F. Harman Lewis, borough electrical engineer, Town Hall, Wolverhampton.

The Lighting Committee invite tenders, accompanied by samples, for the supply of electric fittings suitable for the Town Hall, Art Gallery, School of Art, Free Library and Market Hall. Specifications, &c., may be obtained from Mr. F. Harman Lewis as above.

CLOSED.

Bedford.—The following tenders have been accepted by the Council for the electric lighting installation: T. H. Coleman, for building and chimney, £1,565; Telegraph Manufacturing Company, Limited, for mains and transformers, £2,271; Johnson & Phillips, for plant, £5,200; Grafton & Co., for travelling crane, £85. For fuller particulars see under "Business Notices."

Bradford.—Two new 800 H.P. tubular marine boilers are to be obtained from Messrs. Thwaites Brothers, Limited, of Bradford, at a cost of about £2,875.

Cheltenham.—For erection of a central electric lighting station for the Corporation:—Malvers & Son, £1,799.

BOOKS RECEIVED.

L'Eclairage à Paris. Par Henri Maréchal. Published by Baudry et Cie, Paris.

Mountain, Moor, and Loch, illustrated by pen and pencil. Published by Sir Joseph Causton & Sons, London.

CITY NOTES.

Elmore's Patent Copper-Depositing Company.

THE directors called a meeting of the shareholders at the Cannon Street Hotel yesterday, for the purpose of receiving their resignation, and appointing new directors in their place. The directors' circular says:—"It will be in your recollection that the investigation committee recommended, in the first instance, that local directors should be selected; but, that being impossible at the time, the present directors were appointed. Their work has been done at much inconvenience to themselves, to the best of their ability in the interests of the shareholders; but they feel it most difficult to exercise a proper control over the business without a sacrifice of time which their other occupations render most inconvenient. They are desirous, therefore, of placing their resignation in the hands of the share-

holders, and are, they believe, fully justified in so doing under the conditions which are such as will enable them to present to the meeting the names of local gentlemen of position and ability who are now willing to take over the direction of the company's affairs. It will be evident that the position of the business and condition of the works must be greatly improved, or the proposed new directors would not have been induced to come forward and take a large pecuniary interest in the business, and place themselves in the responsible position of controlling the affairs of the company. After the last meeting £10,000 of 6 per cent. debentures were offered to the shareholders, but, as the issue met with little response, the deposits were returned. The want of capital caused again delay in developing the business, and it was only after some time that an arrangement was come to with our bankers (through the agency of Mr. William Elmore and the guarantee of Mr. A. S. Elmore) to the extent of £15,000. This provides for the purchase of ample supplies of copper and the completion of the needful plant; so that nothing should now be wanting for the accomplishment of profitable results. The Wire Company having obtained capital, an arrangement must now be made with them for the joint use of the furnaces, and, as other important agreements are waiting completion, my directors are desirous that they should be entered into by the new directors, who would then commence their duties with a fuller control of the interests of the business."

A special meeting of this company was held yesterday to consider and accept the resignation of the board of directors which had been in existence since last May. They, the shareholders, were aware that since the board took office they had had to face great difficulties. They had found it necessary last November, as they remembered, to raise fresh capital to carry on the business of the company; they failed to do this, but by an arrangement with the Leeds bankers they were allowed an overdraft of £15,000. The works were put into order, but considering the advances they had received, they did not seem to be making the progress which would lead them to a profit. About this time Mr. William Elmore told them that he could provide directors who knew more about the business, and eventually the board decided that it would be in the interests of the company for the directors to retire, and form a new board. They could confidently recommend the new directors, who, besides being practical men, were on the spot. The names of the proposed directors were Mr. Edward Reynolds, of Sheffield, Mr. J. Marshall, of Sunderland, and Mr. J. North, of Leeds.

On the proposition of a shareholder the resignation of the directors was accepted, and the new names substituted.

The India-Rubber Company.

THE half-yearly ordinary meeting of this company was held yesterday at the Cannon Street Hotel. They had met, said the chairman, chiefly for the purpose of declaring a dividend, which would be 10s. per share, or at the rate of 5 per cent. for the last half year. Notwithstanding the depression in trade they had managed to get a fair share of business. They had done very little on submarine cable work this last half year, but had done well in other departments. The works at Persan-Beaumont and at Silvertown were in a high state of efficiency. After a few more remarks, the payment of the dividend was agreed to.

Edison & Swan United Electric Light Company, Limited.

AN extraordinary general meeting of this company was held on Tuesday at Cannon Street Hotel, Mr. J. Staats Forbes presiding.

The SECRETARY (Mr. H. Charles Gover) having read the notice convening the meeting,

The CHAIRMAN said: "We have called this meeting, not because there was any legal necessity to do so, for this is a matter which was in the competence of the board to commit you to without confirmation. We made it a condition of this bargain, and of the vote we took on behalf of the Swan Company, that the agreement was still open to objection if the Edison & Swan Company, as a separate company, did not confirm it at a meeting of this sort. Therefore we have called the meeting. The Edison & Swan, have such a common interest with the Swan Company, that we thought it prudent to acquire that portion of their business which was not absorbed in the original amalgamation of the British patents. As I explained at the Swan meeting to-day, we came to terms with the Edison Company. There were 'two Richmonds in the field'—the Edison and the Swan—both with patents of a useful character, that might have led to litigation; but instead of fighting we amalgamated, and we did pretty well under that amalgamation. But whereas the Swan had patents over Great Britain, all Europe, and some other places, the Edison Company had only the British patents; therefore all we put into the pot as the Swan Company was the British patents, and we kept the outlying business as a separate matter, and that is represented by a business in Germany, by an investment in the French Edison Company, and so forth. Now we propose to bring it in. The patent period is over. We are now the subjects of active competition, and this being so, we came to the conclusion that it was very desirable to join our forces so as to present a united front to the enemy, not only in Great Britain, but also on the CONTINENT, and for that residuum the Swan Company have agreed to accept £100,000 of debentures. The question we have to determine to-day is whether the Edison & Swan are willing to give that for it. The agreement was negotiated over a somewhat considerable space of time by some very competent gentlemen. There were two gentlemen representing the Edison interest, Lord Lichfield and Sir John Lubbock; while Mr. Swan and Mr. Quilter represented the partly-paid shareholders. These gentlemen, after much deliberation, and a good many arguments as to the proposed price, came to the conclusion that the proposal was a rational and proper solution, and they accordingly recommended it. The boards of both companies have agreed to it, but in order that the scheme may have the *cachet* of the approval of the Edison & Swan proprietors, we thought it respectful and proper, notwithstanding the fact that we have agreed to it, to give them the opportunity to sit upon it if they choose. I now beg to move the following resolution: 'That the provisional agreement, dated June 5th, 1894, submitted to this meeting and expressed to be made between the Swan United Electric Light Company, Limited, and this company for a sale of the Swan Company's undertaking to this company for debenture stock of this company, be and the same is hereby approved.'"

Major FLOOD PAGE seconded the resolution, which was carried unanimously.

Swan United Electric Light Company, Limited.

AN extraordinary general meeting of this company was held on Tuesday, at which Mr. J. S. FORBES, who presided, moved the confirmation of the following resolution, which was passed at the extraordinary general meeting of the company, held June 14th, viz.:—"That the Swan United Electric Light Company, Limited, be wound up voluntarily, and that Henry Charles Gover, of No. 100, Victoria Street, in the City of Westminster, be, and he is hereby appointed, liquidator for the purpose of such winding up, and that the liquidator be, and he is hereby authorised to carry into effect upon the terms of a provisional agreement between the two companies, dated June 5th (subject to any modification), a sale of the company's undertaking to the Edison and Swan United Electric Light Company, Limited, for debenture stock of that company to be distributed among the members of this company."

Major FLOOD PAGE seconded the resolution, which was unanimously confirmed.

Oriental Telephone and Electric Company.

THE first ordinary or statutory meeting of the shareholders of this company was held on Wednesday at Winchester House, Old Broad Street, in compliance with the Companies' Act, 1867.

Mr. WILLIAM ADDISON, who presided, said that the reconstruction arrangements had proceeded satisfactorily. The new company was registered in the afternoon of the day on which the resolution was passed by the old company, and the business had since been conducted without any drawback. There was every reason to believe that the shares were well and firmly held, as there had been but few transfers. The company's business was showing fair progress, the reports from the various agencies and affiliated companies being satisfactory. With regard to India, the volume of business showed a satisfactory increase, but the depreciation of silver necessarily affected them. The new company having only been formed on March 12th, they could not at that meeting bring forward any report or balance-sheet; but they would do so at the earliest opportunity next year, which would probably be in April. As there was no special resolution to put before the meeting, he would be happy to answer any question.

No questions being asked, the Chairman declared the meeting at an end.

Elmore's German and Austro-Hungarian Metal Company, Limited.—Owing to continued ill-health, the chairman, Mr. Rock, has been compelled to resign his seat on the board. Mr. John Heal, of the firm of Bloor & Heal, of Snow Hill, E.C., has been appointed a director of the company. In a circular being sent out by the directors it is stated that Mr. Heal, who is a large shareholder and well known to many of the shareholders, has, after investigation, satisfied himself as to the future of the company, and has taken up a large number of preference shares in addition to those allotted him.

The Kensington and Knightsbridge Electric Lighting Company, Limited.—The dividend for the half-year ending June 30th on the first preference shares, at the rate of 6 per cent. per annum, will be paid on July 13th, 1894.

The City of London Electric Lighting Company, Limited.—Warrants for the interest due the 30th inst. on the company's debenture stock have been posted.

St. James's and Pall Mall Electric Light Company, Limited.—For the half-year just ended the board has declared an interim dividend of 2 per cent.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending July 1st, 1894, amounted to £1,020; week ending July 2nd, 1893, £811; increase, £209; total receipts for half-year, 1894, £23,636; corresponding period, 1893, £22,610; increase, £1,026.

The Cuba Submarine Telegraph Company. The estimated traffic receipts for the month of June were £3,350; as compared with £3,233 in the corresponding month of last year.

The Direct Spanish Telegraph Company, Limited. The estimated receipts for the month of June, 1894, amounted to £1,617, against £1,730 in the corresponding period of last year.

The Western and Brasilian Telegraph Company, Limited. The receipts for the week ending June 29th, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brasilian Telegraph Company, Limited, were £2,370.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1891.	1892.	1893.	Closing Quotation, June 27th.	Closing Quotation, July 4th.	Business done during week ended July 4th, 1894. Highest.	Lowest.
184,500£	African Direct Teleg., Ltd., 4 % Deb.	100	...	...	...	102 —105	100 —103 xd	...	...
1,134,640£	Anglo-American Teleg., Ltd.	Stock	£2 12s.	£2 15s.	£2 11s.	37 — 40	38 — 41	39½	...
2,932,680£	Do. do. 6 % Pref.	Stock	£5 5s	£5 10s.	£5 2s.	70 — 72	72 — 74	77½	71
2,932,680£	Do. do. Defd.	Stock	...	...	...	6¼— 6¾	6½— 7	7 1/16	6⅝
130,000	Brazilian Submarine Teleg., Ltd.	10	8 % §	6½% §	6½% §	12 — 12½	12 — 12½xd	12⅝	12 5/16
18,700£	Do. do. 5 % Bonds	100	...	...	...	101 —104	101 —104	...	...
75,000£	Do. do. 5 %, repayable June 1906	100	...	...	...	109 —113	107 —111 xd	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 40,000	5	... §	10%‖ §	... §	1½— 2½	1½— 2½	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	7 %	139 —143	139 —143	...	...
224,850	Consolidated Telep. Const. and Main., Ltd. ...	10/-	3½% §	2 % §	2 % §	1/16 — 3/16	1/16 — 3/16	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	8 %	12 — 13	12 — 13	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18½— 19½	18½— 19½	...	...
12,931	Direct Spanish Teleg., Ltd., £4 paid	5	4½%	4 %	4 %	4 — 4½	4 — 4½	...	...
6,000	Do. do. 10 % Pref.	5	10 %	10 %	10 %	9 — 9½	9 — 9½	...	...
60,710	Direct United States Cable, Ltd., 1877	20	3½% §	3½% §	...	8 — 9	8½— 9½	9¼	9
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½% §	6½% §	...	15 — 15½	15 — 15½	15⅛	15 1/16
70,000	Do. 6 % Pref.	10	6 % §	6 % §	...	15¾— 16¼	15¾— 16¼	15 5/16	...
105,900£	Do. 5 % Debs., repay. August, 1899	100	...	...	...	107 —110	107 —110	...	...
1,294,100£	Do. 4 % Mort. Deb.	Stock	...	...	...	113 —116	113 —116	115	114¼
£50,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7 %	7 %	15⅛— 15⅜	15¼— 15½	15 7/16	15 3/16
62,700£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	...	...	...	105 —108	103 —106 xd	...	...
222,800£	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	...	...	...	105 —108	103 —106 xd	...	...
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	114 —118	114 —118	...	...
95,100£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	...	...	...	105 —108	103 —106 xd	...	...
129,100£	Do. do. do. to bearer, 2,344 to 5,500	...	...	...	...	105 —108	103 —106 xd	...	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 2,016, red. 1909	100	...	...	...	105 —108	105 —108	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	...	...	...	107 —110%	107 —110%	...	...
180,227	Globe Telegraph and Trust, Ltd.	10	5¼% §	4⅛% §	4⅝% §	8⅛— 8¾	8⅛— 8½	8⅜	8 5/16
180,042	Do. do. 6 % Pref.	10	6 % §	6 % §	6 % §	15 — 15½	15⅛— 15⅜	15⅜	15⅛
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅜% §	8⅜% §	8⅜% §	21 — 21½	20½— 21 xd	21	20½
200,000£	Do. do. do. 5 % Debs.	100	...	...	...	105 —108	105 —108	...	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	10 %	43 — 45	43 — 45	...	...
37,548	London Platino-Brazilian Teleg., Ltd.	10	...	...	...	5 — 7	5 — 7	...	...
100,000£	Do. do. 6 % Debs.	100	...	...	...	107 —110	107 —110	...	...
15,000	Monte Video Teleph. Co., Ord., 1 to 15,000	5	...	...	...	½— 1½	½— 1½	...	...
28,000	Do. do. 6 % Pref., 1 to 28,000	5	...	...	...	1 — 2	1 — 2	...	...
484,597	National Teleph., Ltd., 1 to 438,984	5	6 % §	5 % §	...	4⅞— 5⅛	4⅞— 5⅛	5 1/16	4⅞
15,000	Do. 6 % Cum. 1st Pref.	10	...	...	...	15 — 16	15 — 16	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	...	...	...	14½— 15½	14½— 15½	15	...
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 90,950	5	...	...	...	5⅝— 5⅞	5⅝— 5⅞	5⅝	5⅝
925,017£	Do. 4½ % Deb. Stock Prov. Certs. ...	...	...	...	...	112 —115	109 —112 xd	...	...
48,800	New Teleph., Ltd., 25,901 to 74,700; £4 paid	10	...	...	...	... ...	... ...	...	...
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	...	...	...	⅜— ⅝	⅜— ⅝	...	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	...	...	...	103 —106	101 —104 xd	...	...
11,839	Reuter's Ltd.	8	5 %	5 %	...	5 — 6	5 — 6	...	...
3,381	Submarine Cables Trust	Cert	...	...	...	108 —113	110 —115	...	...
58,000	United River Plate Teleph., Ltd.	5	...	...	...	1½— 2	1½— 2	...	...
146,370£	Do. do. 5 % Debs.	Stock	...	...	...	90 —100	90 —100 xd	...	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	4 %	..	...	3 — 5	3 — 5	...	...
249,900£	Do. do. do. 5 % Debs.	100	...	...	...	102 —105	102 —105	...	...
30,000	West Coast of America Teleg., Ltd.	10	...	...	...	2½— 3	2½— 3	...	...
150,00 £	Do. do. do. 8 % Debs., repay. 1902	100	...	...	...	100 —105	96 —101 xd	...	...
64,242	Western and Brazilian Teleg., Ltd.	15	4 %	2½%	5 %	6½— 7	6½— 7	7	6½
33,129	Do. do. do. 5 % Cum. Pref. ...	7½	...	...	...	5¾— 6½	5½— 6½	...	...
33,129	Do. do. do. 5 % Def.	7½	3 %	...	...	2 — 2½	1¾— 2¼	2	...
178,200£	Do. do. do. 6 % Debs. "A," 1910 ...	100	...	...	...	107 —110	107 —110	...	...
222,700£	Do. 6 % Mort. Debs., series "B," red. Feb. 1910	100	...	...	...	107 —110	107 —110	...	...
88,321	West India and Panama Teleg., Ltd.	10	¼%	¼%	⅜%	1⅛— 1⅜	1 — 1¼	1 1/16	...
34,563	Do. do. do. 6 % 1st Pref. ...	10	...	...	...	10 — 10½	10 — 10½	10½	10
4,669	Do. do. do. 6 % 2nd Pref. ...	10	...	...	...	9 — 10	9 — 10	...	...
80,000£	Do. do. 5 % Debs. (1917) No. 1 to 1,000	100	...	...	...	109 —112	107 —110 xd	...	...
$1,214,000	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	...	...	...	110 —115	115 —120	115	113½
169,000£	Do. do. 6 % Ster. Bonds.	100	...	...	...	100 —104	100 —104	103½	101½

ELECTRICITY SUPPLY COMPANIES.

20,510	Charing Cross and Strand Electy. Supply, 1 to 6, 215 to 718, and 10,001 to 30,000	5	...	5 %	4½%	4½— 5½	4½— 5½	...	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	...	...	...	12½— 13½	12½— 13½	13⅛	12⅞
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	...	6 %	6 %	13⅜— 14½	13⅜— 14½	14⅛	14
100,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	87 — 90	127 —130 xd	...	...
45,000	†Liverpool Electric Supply, £4 10s. paid	5	4½%	5 %	5 %	6⅜— 6½	6⅜— 6½	...	...
49,900	*Metropolitan Electric Supply, Ltd., 6,101 to 50,000 ...	10	1 %	2 %	2½%	8½— 9	8½— 9	8¾	8½
100,000£	Do. 5% Deb., 1 to 10,000 in bonds of £10, £20, £40	...	...	...	...	108 — 111	108 —111	...	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	...	...	...	4½— 5½	4½— 5½	...	...
19,980	St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-18,780	5	8½%	7½%	4½%	7 — 7½	7 — 7½	...	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8¼— 8¾	8½— 9	8½	...
59,900	*Westminster Electric Supply Corp., Ord., 101 to 60,000 ...	5	...	3½%	4 %	6¼— 6¾	6¼— 6¾	6¾	6⅝

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1891.	1892.	1893.	Closing Quotation, June 27th.	Closing Quotation, July 4th.	Business done during week ended July 4th, 1894. Highest.	Lowest.
90,000	Brush Elecl. Enging. Co., Ord., 1 to 90,000	3	...	6 % §	6 % §	2¾— 3	2⅞— 3	3	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	...	6 % §	6 % §	2⅛— 2⅜	2⅛— 2⅜	2 5/16	2¼
125,000/	Do. do. 4½ % Deb.	Stock	...	...	...	109 —112	109 —112	...	...
630,000/	City and South London Railway	Stock	...	⅝%	⅝%	36 — 38	36 — 38	36½	...
20,000	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 20,000	5	7 % §	7 % §	7 % §	2¾— 3¼	2⅞— 3¼	...	...
50,000/	Do. do. 5 % 1st Mort. Debs., 1—400 of £100, and "A" 1—200 of £50 each	...	...	...	...	95 —100	95 —100	...	...
120,000	Electric Construction, Ltd., 1 to 120,000	2	...	...	...	¼— ⅜	¼— ⅜	...	...
12,845	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	2	...	...	...	1½— 1⅝	1½— 1⅝	...	...
100,000	Elmore's French Patent Cop. Deposg., Ltd, 1 to 66,750 ...	2	*nil*	*nil*	*nil*	¼— ⅜	¼— ⅜	...	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil* ¶	*nil*	*nil*	1 — 1¼	1⅛— 1⅜	1 5/16	1⅛
67,385	Elmore's Wire Mfg., Ltd., 1 to 67,385, issued at 1 pm. ...	2	*nil*	*nil*	*nil*	⅞— 1⅛	⅞— 1⅛	1	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300	5	*nil* §	*nil* §	*nil* §	½— 1⅛	½— 1⅛	...	...
9,600/	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	...	...	6½— 7½	6½— 7½	...	...
6,837	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	5 %	5 %	5 %	6½— 7½	6½— 7½	...	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	12½%	12½%	12½%	23½— 24½	23½— 24½	24¼	23¾
200,000	Do. do. do. 4½ % Deb., 1896	100	...	...	...	103 —105	103 —105	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	...	...	1 %	8 3/16— 8 5/16	8¼ — 8¼	8¼	...
6,295	† Do. do. Pref., £8 paid	10	...	...	...	12⅞— 13⅛	12⅞— 13⅛	...	...
78,949	Swan United Electric Light, Ltd., £3½ paid	5	11 % §	10 % §	7½% §	2 — 2⅛	... — ...	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	20 %	15 %	20 %	40 — 42	40 — 42	...	...
150,000/	Do. do. do. 5 % Bonds, red. 1894	100	...	...	...	104—107	102 —105 xd	...	...
54,000	Waterloo and City Railway, Nos. 1 to 54,000, £2 paid ...	10	...	...	...	... ..	2 — 2¼	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50% for 1890.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.
Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0% §; 1891—7% §; 1890—8% §.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Birmingham Electric Supply Company, Ordinary of £5 (fully paid), 5¼—5⅜.
Electric Construction Corporation, 6 % Debentures, 87—92.
Electric and General Investment, shares of £5 (£1 paid), 1¾—2¼.
Electricity Supply Corporation, Ordinary of £5, 5—5¼.
House-to-House Company (£5 paid), 1—1⅛.
Do. do. 7 % Preference, of £5, 5¼—5½.
Do. do. 6 % Debentures of £100, 101—103.
Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 4⅜—5¼; 1st Preference Cumulative 6 %, £5 (fully paid), 6¼—6⅜.
Liverpool Electric Supply, £5 (fully paid), 6½—6⅝.
Do. do. £3 10s. paid, 4½—4⅝.
London Electric Supply Corporation, £5 Ordinary, ⅞—1⅛.
Queen Anne's Mansions Lighting and Heating Company, 6 % £100 Debentures, 101—103.
Yorkshire House-to-House Electricity Company, £5 Ordinary Shares (£4 10s. paid), 4¼—4⅜.

Bank rate of discount, 2 per cent. (February 22nd, 1894).

POWER LOSSES IN THE TRANSMISSION MACHINERY OF CENTRAL STATIONS.*

By Wm. S. ALDRICH.

This paper had its unexpected origin in correspondence with the secretary of the Society after Volume xiv. of the *Transactions* had been completed. It was deemed advisable to add some memoranda on the subject of power losses in the transmission machinery of central stations, which had come within the author's experience, and some of which were incompletely referred to in the discussion of Paper No. dxlvi., on the "Performance of Street Railway Power Plants," presented at Chicago meeting (July, 1893), by Messrs. Wm. A. Pike and T. W. Hugo.

The contents of the present paper are outlined below:

1. A revision of the author's discussion of Paper No. dxlvi.
2. An analysis of Paper No. dxlvi., with reference to the power losses in the transmission machinery.
3. A memorandum of the power losses in a turbine plant for an electric railway.
4. A memorandum of the power losses in a cable plant.
5. Results of some tests to determine the power losses, in transmitting through a countershaft.

1.—Revised Discussion of Paper No. dxlvi.

Table XVI., page 1,146, Vol. xiv., of the *Transactions* of this Society, of the combined horse-powers of the St. Paul test, No. 2, from cards taken every 10 minuter, cannot possibly show the real variations of power in an electric railway plant. The frictional losses in the transmission machinery are best determined by special tests, before or after the regular run, having this one object in view. In this way the losses in the engine, transmission machinery, shafting and empty cables, were determined in a joint test of a cable railway plant, made by Mr. Hermann S. Hering and the author.

It is that which leads me to consider the statement made on pages 1,099-1,100, regarding the loss in friction as obtained by taking the difference between the mechanical and electrical horse-power. It is true that such is the usual method pursued. In a joint test of an electric railroad, made in 1891, by Mr. Hermann S. Hering and the author, they found that it was impossible to arrive at any satisfactory conclusion as to what became of the motive power generated to drive the dynamos, when throwing the load on and off again as quickly as it is done in an electric railroad. At times there would be as much as 40 H.P. unaccounted for; that is, for a few seconds the dynamo output would fall more than 80 H.P. below the then delivered turbine horse-power; while, at other times, the horse-power delivered by the turbines and the dynamos would be equal. Under light load conditions, which remained steady for about two minutes at one portion of the run, the actual difference between the turbine horse-power and dynamo horse-power delivered was 43·8. All at once, while the turbines were decreasing their output, there would be 50 or 60 H.P. thrown off or on the dynamos, and the turbine gates would keep on closing. At other times the same thing would happen while the turbines were increasing their output, and the turbine gates would keep on opening, causing the difference of power between that delivered by the turbines and that delivered by the dynamos to the line to run enormously high; the maximum difference so observed was 140 H.P., or almost 100 H.P. in excess of that lost in the transmission machinery and dynamo.

Between these extremes one can readily see that the transmission machinery acts in the way of a fly-wheel, storing up the excess of energy on the one hand, and giving out part of

* Presented at the Montreal meeting (June, 1894) of the American Society of Mechanical Engineers.

its stored energy during a deficiency on the other hand. These great differences of power exist only for a few seconds. The dynamo load does not go down or up to a definite point and stay there, so permitting the turbine to settle to its new load; but, while the turbines are seeking to adjust themselves to the new requirements, the dynamo load has either gone farther in the same direction, or immediately changed about to the opposite condition. We took the ground that these gross irregularities were largely inherent in a turbine plant.

In writing our report on this test for the *Electrical World* (May 28th to July 30th, 1892), we stated that steam engines would not be at all likely to show the same results of great excesses and deficiencies of output, while the dynamo load continued to vary in its characteristic fashion for street railway purposes. We are greatly surprised, therefore, to find that the tests of Messrs. Pike and Hugo, on the Corliss engines of the Minneapolis and St. Paul electric railway plants, do show up much the same as in our turbine tests referred to. They even note that, when lightly loaded, the difference between the engine and dynamo output is *minus*, showing that the dynamos are delivering more power than the engine, similar to the case we have cited for the turbine plant. While they believe this peculiarity to be due to imperfect (better, *tardy* regulation) we think it is due almost entirely to the fly-wheel action of the transmission machinery. We took the ground that a steam engine ought to be able to regulate itself more quickly and closely than a turbine, on account of the elastic nature of the working fluid. Probably it would, if it did not have such a drag upon it as heavy transmission machinery and countershafting, in addition to being driven by an incompressible working fluid.

Steam engines are supposed to be capable of closer and more accurate regulation than turbines, by reason of this very different nature of the working fluid employed. The regulation test of the high speed automatic engines, noted on page 1,116, shows that from a very heavy load to a mere friction load the engine regulated in four revolutions, or on second of time. It is believed that still quicker regulation will come to be the ordinary practice in high speed automatic engines.

Now, I think it is a very important point to bear in mind that a high speed automatic engine may be made to meet the rapidly changing loads in an electrical power plant with an almost equal economy. If we take the two papers presented at this meeting—the Laketon test of a triple-expansion pumping engine, in which the load is quite uniform; and the present test of electric railway engines, in which the loads are very irregular—we find much food for thought.

The main point which I wished to bring out in this discussion is that the high speed automatic engine, directly connected (or better, directly coupled), is best adapted to meet the sudden and very great variations in electric power plants, while the well known type of Corliss engine seems best adapted to steady loads.

2.—Analysis of Paper No. dxlvi., with reference to the Power Losses in the Transmission Machinery.

The following table, No. 1, contains a brief presentation of the principal figures in this connection, from the paper under discussion. It is quite important to notice the increase of frictional losses in the St. Paul test, No. 2, in which the power is transmitted to the dynamos, through the friction clutches on the countershaft. It is probable that there is great frictional loss in the use of certain forms of friction clutches, or in old and ineffective parts. In this connection also, it is to be especially noted that this No. 2 test was one in which there were belt tighteners used. No doubt a great loss may be accounted for here, also. Both of these causes may have operated to raise the per cent. friction from 12·10 of No. 1 to 17·40 of the No. 2 as tabulated.

Fig. 1 contains a plot of the differences between the mechanical and electrical horse-powers, of fig. 387, opposite page 1,098, as given by Messrs. Pike & Hugo for the Minneapolis Test, No. 1. The characteristic variations are to be especially noted, sometimes the mechanical is in excess, sometimes the electrical. The dotted horizontal line shows the mean value of this difference—the value given on page 1,097, for the mean loss by friction, of 149·9 H.P., and as given in Table I., for this test.

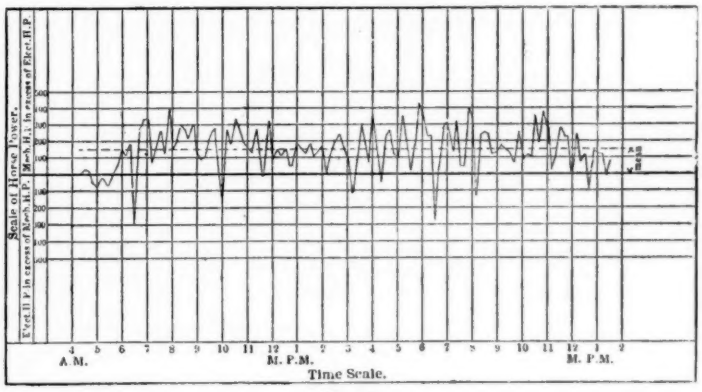


Fig. 1.

3.—Memorandum of the Power Losses in a Turbine Plant for an Electric Railway.

The following particulars of the performance of the turbine power plant of the Neversink Mt. Electric Railway, Reading, Pa., have been taken from the authors' reprint of the published report of the test, as it appeared in the *Electrical World*, May 28th to July 30th, 1892. At the special request of this journal, Mr. Hermann S. Hering and the author made a series of tests of this plant, from August 17th to 22nd, 1891.

The plan and elevation of the turbine plant are shown in fig. 2.

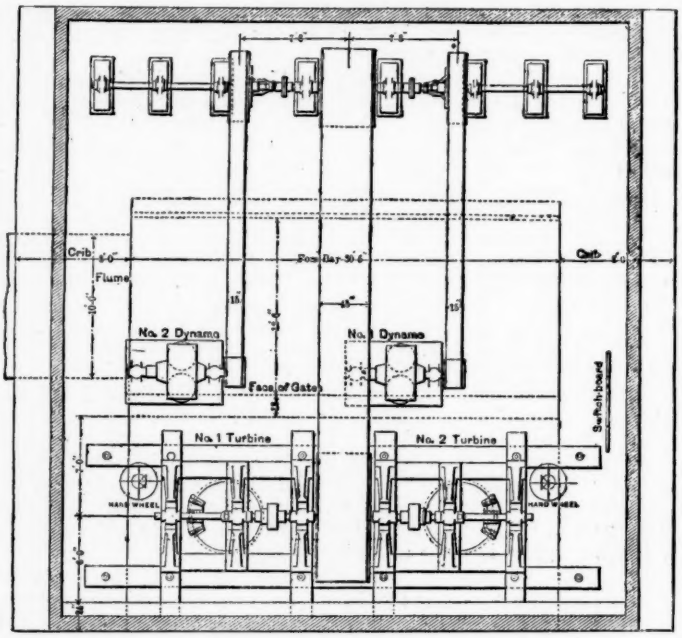
Each vertical shaft of the two Hercules turbines transmits its power through a mortise crown and jack gear to the

Table I.—Analysis of Power Losses in Minneapolis and St. Paul Tests of Paper No. dxlvi.

No. of test.	Location of plant.	Kind of engine.	How connected to dynamo.	Ind. H.P. delivered by engine.	Electrical H.P. delivered by dynamos.	Engine friction H.P. by friction run.	Per cent. engine friction.	Total friction H.P. = I H.P. – electrical H.P.	Per cent. total friction H.P.
1	Power house, No. 1, Minneapolis.	Tri-cylinder cond. Corliss.	By countershaft.	1,237·90	1,088·0	...	...	149·90	12·10
2	Hill St. Power House, St. Paul.	Tri-cylinder cond. Corliss.	By countershaft carrying friction clutches.	756·20	624·7	...	...	131·50	17·40
2*d*	Same.	Same.	Same.	859·73	...	...	...	164·43*	19·12
3*b*	31st St. Power House, Minneapolis.	Westinghouse compounds.	Belted direct to dynamo.	522·50	434·2	14·27	3·7†	88·30	16·90

* Friction horse-power of engine, transmission machinery, and mechanical and electrical losses in dynamos, obtained by indicating engine with no load on the dynamos.

† Per cent. engine friction, as compared the maximum horse-power of any one engine.



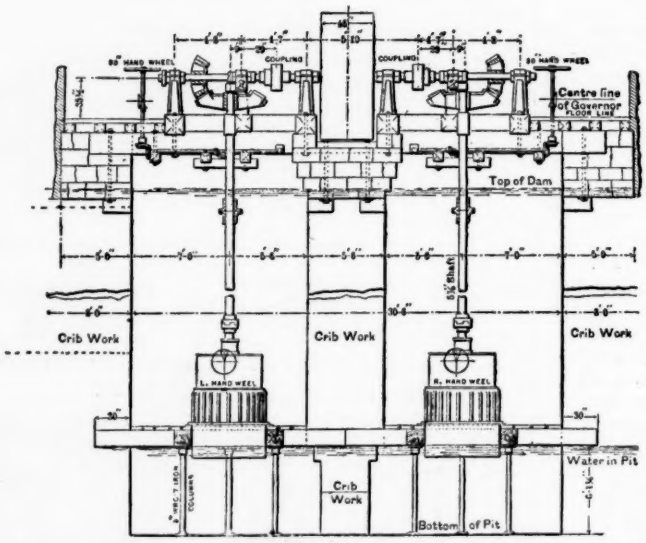


Fig. 2.

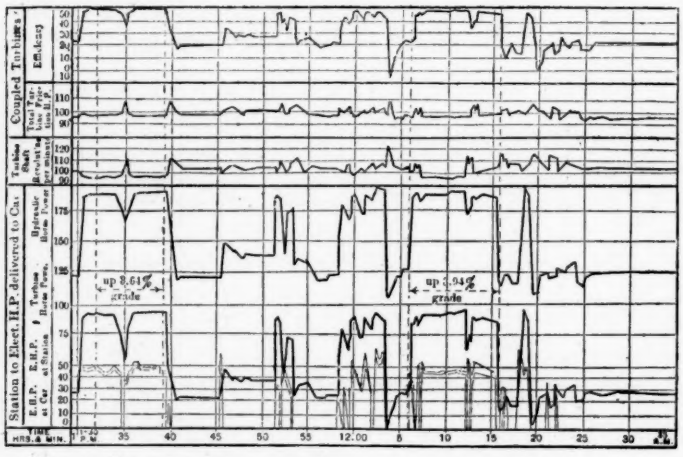


Fig. 3.

horizontal shaft carrying the main driving pulley. The power is thence transmitted to a countershaft, from which each dynamo is belted by means of a friction clutch pulley.

Table II. contains the details of the turbine installation, and Table III. of the transmission machinery.

The turbine data for the test was obtained from the Holyoke Machine Company, through whose kindness the authors were furnished with a complete test-sheet of the actual performance of a 45-inch Hercules turbine, of exactly similar design to those here used.

Performance of the Turbine Plant under a Light Load.

In this, known in our report as the "Special Car Test," observations were made to determine the distribution of power, and the several losses from the hydraulic head of the water to the available power at the car axle, during the run of a single car over the road. The graphical log of the test, so far as the present paper requires, is shown in fig. 3.

Fig. 4 shows the variations of the losses from the turbine shaft to the dynamo terminals, obtained by taking the instantaneous differences between the turbine horse-power and dynamo output, and plotting on the same time base as fig. 3. The horizontal dotted line shows the mean (from the integrated means) for the section marked off by the vertical dotted line.

Table IV. contains the more interesting and important observed and mean values, taken from fig. 3, and Table V. the summary of the power distribution and efficiencies.

A noteworthy feature of this test is that the No. 2 turbine was run throughout with a fixed gate at 17·4 per cent. proportional part of the full opening of the speed gate. The regulating was entirely done by the No. 1 turbine. Anomalous conditions frequently arise when one of the turbines is thus operated at a fixed gate, as will be readily seen upon an examination of the graphical log, fig. 3.

Performance of the Turbine Plant under a Heavy Load.

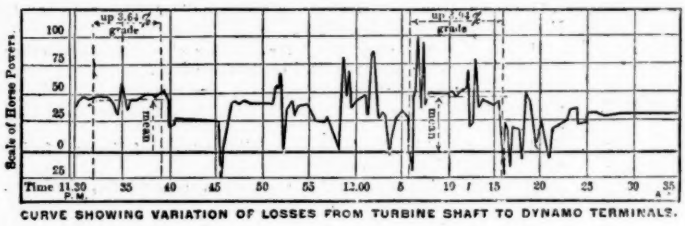
This is designated the "Test of the Power Plant" in our report, and observations were made similar to those referred to in the special car test. The graphical log, as far as relates to the present paper, is shown in fig. 5, and the variations of the power losses from the turbine shaft to the dynamo terminals in fig. 6, in which the horizontal dotted line shows the mean (from the integrated means), as before.

Table VI. contains the observed and mean values from fig. 5, and Table VII. the summary of the power distribution and efficiencies. The time base of the graphical log was divided into two sections, each of which possessed typical groups of changes, and the several values are given for these sections, as well as for the entire run.

In each of these tests there were marked peculiarities in the variations of the power losses between the turbine and the dynamo output, as noted in the discussion. It was believed that these were inherent in turbine plants only, but from a similar plot of the Minneapolis test, No. 1, given in section (2), it is apparent that the same difficulties are being experienced in electric railway plants driven by Corliss engines.

Average Power Distribution of the Turbine Plant.

The mean values for the several losses in the distribution of the power (mean speed of turbines at 100 revolutions) have been plotted in the curves in fig. 7. These do not represent



CURVE SHOWING VARIATION OF LOSSES FROM TURBINE SHAFT TO DYNAMO TERMINALS.

FIG. 4.

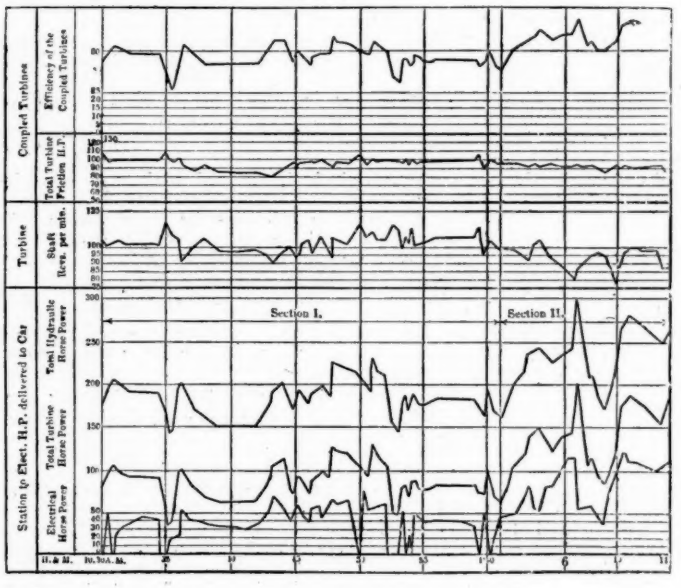
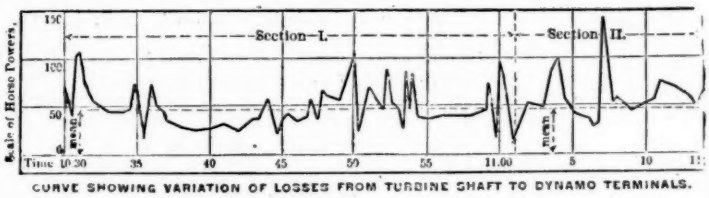
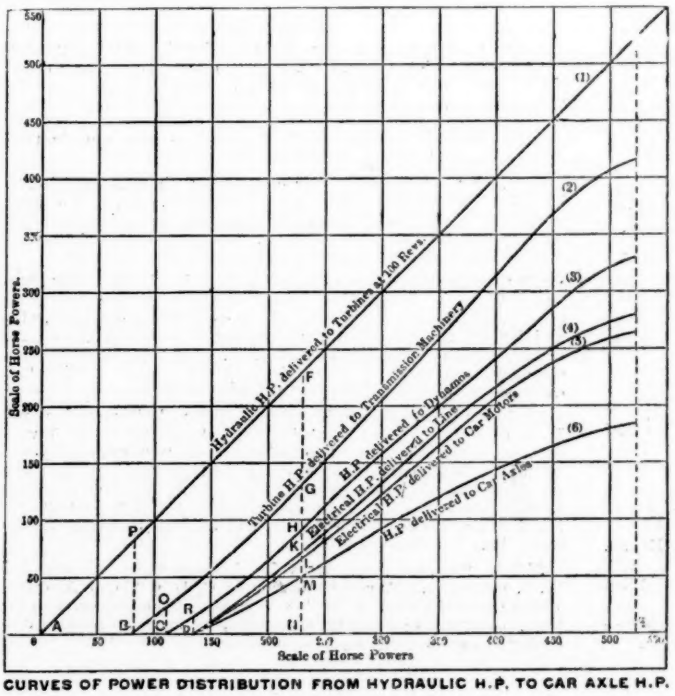


FIG. 5.



CURVE SHOWING VARIATION OF LOSSES FROM TURBINE SHAFT TO DYNAMO TERMINALS.

FIG. 6.



CURVES OF POWER DISTRIBUTION FROM HYDRAULIC H.P. TO CAR AXLE H.P.

FIG. 7.

the means, integrated or otherwise obtained from few or many observations, nor do they show just the state of affairs at any one moment. They are rather to be considered as general average values, showing, by simple inspection, the proportional distribution of losses, and the final power available at the car axle for the various horse-powers up to the maximum hydraulic capacity of the station. It would, of course, be possible to obtain such a distribution of the power as is here shown, if the turbine speed could be maintained constant for such a length of time that the station performance would settle down to steady conditions, on the one hand; while the distribution and load of the cars out on the road should be almost uniformly maintained, on the other hand. The disturbing element in the station performance as here represented is the variable turbine speed; and with regard to the road conditions, it is the varying position of the cars *en route*, and the changing loads on the motors due to varying grades and the somewhat irregular passenger traffic. However, taking all these matters into consideration, the curves convey a very good idea of the relations between the successive losses.

The diagonal line marked (1) represents the H.H.P. delivered to the turbines at 100 revolutions, and for which either the horizontal or vertical scale of horse-powers may be used. The curve (2) is the T.H.P. delivered from the turbine shaft to the transmission machinery. It has been obtained for the several hydraulic horse-powers from the curves which the authors plotted from the data furnished by the Holyoke Machine Company. The horizontal distance, A, B, fig. 7, represents the H.H.P. required to drive the two turbines with no output; and that for any other turbine output, as G, N, is measured by the horizontal distance, A, N. It is to be carefully noted that the horizontal and vertical distances for any points, as A, B, and B, P, or A, N, and N, F, are equal only when referring to points on the diagonal line (1) of H.H.P.

The curve of horse-powers delivered to the dynamos (3) was obtained from a curve of power losses in the transmission machinery at the constant speed given above, and which losses have been set off from the points along (2) for any given horse-power delivered from the turbine shaft. The losses in the transmission machinery were obtained partly from observations made during the test and from calculations based on the dynamo output and efficiency. The point, C, and its ordinate, Q, C, refer to conditions of the station test, when all the available T.H.P. was absorbed in the transmission machinery, the dynamos being unclutched.

The curve (4) of E.H.P. delivered to the line shows the dynamo output as measured at the switchboard, and its vertical distance as H, K, at any point represents the total mechanical and electrical losses in the dynamos for that proportional part of the dynamo output. As before, the point, D, and its ordinate, D, R, correspond to conditions in which all the available T.H.P. is absorbed in the transmission machinery and dynamo losses, fields excited, but zero amperes at the switchboard. The efficiency of the dynamos at any particular output is shown by the ratio of the respective ordinates of (4) and (3), as N, K, divided by N, H. The losses represented by the vertical distance at any point between (3) and (4), as H, K, comprise the following:—Mechanical friction of the journals in the bearing and of the air resistance, 1·34 H.P., and was assumed fairly constant under uniform speed at the different loads; hysteresis, Foucault currents and losses on the shunt fields, 4·22 H.P., also fairly constant under the same conditions; and the variable C^2 R losses in the armature and the series field coils calculated from resistances with temperature corrections.

(To be continued.)

AN AMERICAN VIEW OF THE COST OF PRODUCING ELECTRICITY.

Our contemporary, the *Electrical World*, in reporting through the pen of Mr. Jas. B. Cahoon, upon the meeting of the National Electric Light Association, makes some very pertinent remarks upon the keeping of accounts. The committee on data giving their report upon the watt hours, kinds of coal and other data from 65 stations in various parts of the country, show that as a whole the central stations do not keep an account of the fuel consumption per watt-hour, and in many cases where this is poor it indicates fitfulness in operation and poor firing. Three stations show no less a coal consumption than 20 pounds per horse-power indicated!!! and many others show between 10 and 20 pounds. The majority show over 5 pounds of coal per H.P. hour. Averaging different kinds of coal and placing them in four lists under the heads of slack, bituminous, small hard, and screenings, Mr. Cahoon finds that sixteen slack users show 72·75 watt hours per pound of coal, 10 users of bituminous give 75·6 watt hours, small hard shows 116·4 watt hours in twelve cases, while two users of screenings actually head the list with 183 and 208 watt hours per pound respectively. Against these results from poor coal is to be set the Youghiogheny coal, supposed to be at the head of the steam coals of America with only 83 and 104 watt hours from two users. Mr. Cahoon argues that if large manufacturing concerns can produce a horse-power per each 1½ pound of fuel, then it ought to be possible for central stations to do equally well in the large cities, and in the smaller cities to obtain 1 H.P. per each 2½ lbs. of coal.

Mr. Cahoon considers these figures within the bounds of reason. He gives a table, which we need not reproduce, of the theoretical value of various American coals, from 14·76 pounds of water evaporated to 12·65 pounds, with a view to showing, what we may say is also the fact in England, that there is not that great variation in the value of fuels that many suppose, and he therefore does not consider any section of the country has a right to claim indulgence for poor results on any basis of poverty of fuel. He gives a diagram showing how the watt hours per pound of coal may be at once found for any given tonnage of coal at different rates per I.H.P. Some remarks as to the variation in labour cost when the duty is just too much for one man or two men, necessitating an extra man only partially employed, are a little strained. As things usually go the extra man ought to be able to save the excess in wages by adding to the efficiency of the better attended furnaces.

Regarding the all important item of condensation he instances the case of a station with a maximum output of 1,500 H.P. in small units which was made to draw its water from the harbour 1,200 feet distant, saving thereby 7¾ tons per day, or fully £5 at the price of the coal. The interest on the investment is not one half the saving, so that the annual saving is over £1,000 commercially, not to mention, of course, that this is further equivalent to adding to the capacity of the steam plant so as to put off the necessity of extending with extending business so soon as would otherwise have been necessary.

The neglect of condensing in many electrical stations is really remarkable, and hardly in keeping with the professions of economy so often made. It is the more remarkable where water is at hand and boiler feed is purchased.

NEW PATENTS—1894.

11,733. "Improvements in or appertaining to electrical railways or tramways." R. Altschul. Dated June 18th.

11,780. "Improvements in the means of distributing alternating electricity." D. Cook. Dated June 18th.

11,802. "Improvements in gas engines." H. T. Dawson. Dated June 18th.

11,809. "Electrical life preserving fire alarm." J. B. Rolfe. Dated June 19th.

11,813. "Improvements in phonographs." F. Woilliard-Rigg and H. E. Scarborough. Dated June 19th.

11,814. "Automatic auxiliary electric block, and engine distance caution signal for railways." W. G. Martin. Dated June 19th.

11,815. "An improved electrical indicator." A. Eckstein and A. E. Mitchell. Dated June 19th.

11,822. "A new attachment for hanging electroliers and other electric fittings." A. Marsden. Dated June 19th.

11,840. "An instrument for finding the direction of induced current, rotation, or magnetisation in an electric generator or motor." J. W. Meares. Dated June 19th.

11,843. "To illuminate by electricity castings of flowers, fruits, and foliage taken from nature for the purpose of decoration in plaster either cornices, centre ornaments, entablature, &c." C. Gillard. Dated June 19th.

11,861. "Improvements in electric belts." H. H. Lake. (Communicated by E. M. Miles, United States.) Dated June 19th. (*Complete.*)

11,880. "Improvements in turbines." G. M. Hopkins. Dated June 19th. (*Complete.*)

11,903. "Improvements on conduit electric systems for supply of current to tramway, rail, or other motors." A. A. Govan. Dated June 20th.

11,979. "Improvements in or relating to metal brushes for dynamos." W. von Braucke. Dated June 21st.

11,983. "Improvements in gas or oil engines." J. Mackintosh. Dated June 21st.

11,995. "Improvements in testing and working electric telegraphs." W. Thomson (Baron Kelvin.) Dated June 21st.

12,006. "Improvements in iron clips for fixing electric light casing and other purposes." C. Bishop. Dated June 21st.

12,009. "An automatic electrical switch." W. R. V. Marshall. Dated June 21st.

12,033. "An improved automatic smoke consumer and fuel economiser." J. Butler. Dated June 21st.

12,099. "Improvements in the construction of armatures for dynamo-electric machines and electric motors." H. F. Joel. Dated June 22nd. (*Complete.*)

12,100. "Improvements in or connected with signalling electrically to locomotives or trains in motion." J. W. Sunderland and G. Bilbrough. Dated June 22nd.

12,131. "Improvements in electric brake operating mechanism for vehicles." L. E. Freedley. [Date applied for under Patents &c. Act 1883, Sec. 103, December 29th, 1893, being date of application in United States.] Dated June 22nd. (*Complete.*)

12,137. "Improvements connected with a combined walking stick and electric lamp appliances." H. Newbold. Dated June 22nd. (*Complete.*)

12,140. "Improvements in electric igniters." A. A. C. Swinton. Dated June 23rd.

12,147. "An improved electrical gripper bar, applicable to printing machines." W. B. Silverlock. Dated June 23rd.

12,183. "Underground electrical propulsion." J. E. Parker. Dated June 23rd.

12,221. Improvements connected with electrical furnaces." P. M. Justice. (Communicated by E. G. Acheson, United States.) Dated June 23rd.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1893.

6,170. "Improvements in apparatus for forming earthenware electric switches and the like." M. D. Hollins and J. Meir. Dated March 23rd. Has for its object first an improved arrangement of the "dies" and moulding box described in a former specification; secondly, the improvements refer to an improved tapping tool for forming the screw threads in holes in the base more quickly than heretofore. 2 claims.

8,571. "Improvements in or connected with cells for electric batteries." H. C. W. Emery. Dated April 28th. Refers to cells or containers for electric batteries, whereby, when the cell or battery is not required for use, its position can be changed, and the excitant thereby automatically removed from the electrodes. 3 claims.

9,864. "Improvements in electrical switches." R. G. Evered and A. Watson. Dated May 17th. Claim:—In electrical switches the combination of a spring lever of the construction described, with an internally notched collar for operating the said spring lever for making or breaking contact in the switch, the parts being arranged, combined, and operated substantially in the manner hereinbefore described and illustrated in the drawing.

20,816. "Improvements in connectors for electric conductors." H. R. Keithley. Dated November 2nd. According to this invention, the adjacent ends of two railway rails are connect d by the usual fastening devices, the webs being provided with holes extending therethrough. The rail bond consists of a rod, bar, or wire having at its ends tubular or thimble-shaped terminals made of proper size for insertion into the holes in the webs, and adapted to closely fit the said holes. 1 claim.

23,881. "Improved apparatus for heating metals electrically." W. P. Thompson. (A communication by C. L. Coffin, of America.) Dated December 12th. Consists in increasing the area affected by the arc by causing it to rotate or reciprocate, by using an annular conductor and a stationary magnet. 3 claims.